QUEENSLAND

BUREAU OF SUGAR EXPERIMENT STATIONS

DIVISION OF ENTOMOLOGY

.... BULLETIN No. 2. ....

The Cane Grubs of Australia

By

A. A. GIRAULT and A. P. DODD

1915

BRISBANE
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Bureau of Sugar Experiment Stations,
Brisbane, 20th November, 1914.

The Under Secretary,
Department of Agriculture and Stock,
Brisbane.

Sir,—I have the honour to submit for publication Bulletin No. 2 of the Division of Entomology of the Bureau of Sugar Experiment Stations entitled "The Cane Grubs of Australia," by Messrs. A. A. Girault and A. P. Dodd.

I have, &c.,

HARRY T. EASTERBY,
General Superintendent.

The Cane Grubs of Australia.

By A. A. GIRAULT and A. P. DODD.

The following are preliminary results of the investigations on Scarabæid larvæ injuring sugar-cane commenced by the Queensland Government late in 1911:—

Part I.—Descriptive Matter.

THE descriptions of the larvæ have been made with a half-inch Coddington lens. In all descriptions, larvæ in normal position, but the head with the face directed dorsad.

The descriptions of the larval stages of *Anoplognathus boisduvali* Boisd., *Lepidiota albohirta* Waterh., and *Cacachroa decorticata* Macl., have been offered for publication elsewhere in contributions from the Entomological Laboratory of this Bureau.

In the key to the species we have endeavoured to arrange them in their relations to each other, eliminating at once the distinct larvæ, but until the adults are known it cannot be ascertained how far we have succeeded. The numbers given are purely *arbitrary* (but are real accession numbers), serving to designate the unknown species. With regard to the unknown species, No. 364 is one of the dung-feeding series, No. 576 is possibly *Horonotus optatus* Sharpe, while the small related species (*e.g.*, Nos. 650, 653, 587, &c.) are probably *Haplonycha*, *Liparetrus*, and other small Scarabæids. No. 89, which we have called a species of *Lepidiota*, is very possibly no such thing, and is perhaps more closely related to *Anoplognathus*, *Calloodes*, *Repsimus* (&c.), than to *Lepidiota*.

All Scarabæid larvæ living in the soil met with by us have been included. The table of species should aid greatly in identifying the various grubs to be met with in the soils of the extreme northern cane regions of Queensland. It is of importance in providing a starting-point for future investigations, but can be improved as the latter proceed. Mr. A. M. Lea has identified the adults.

DIAGNOSTIC ARRANGEMENT OF THE LARVÆ.

(1) Body short and stout, the thorax narrowed, the abdomen dorsad rising and forming a large hump.
Head not narrowed; size medium .. .. = No. 364.

Body rarely short and stout, the thorax not narrowed, the whole body dorsad convex, not forming a hump .. .. = (2).

(2) Body widest at the thorax; middle pair of legs somewhat longer than either first or third; thoracic peritreme open along cephalic margin; mandibles straight, the penicellus absent; lacinia and galea distinctly separated; spiracles with an open transverse slit.

Size medium large; peritremes flattened, very open, decreasing in size caudad, very small on last three abdominal segments; epicranium large, smooth, polished, with a very few scattered pin-punctures; left mandible with five acute teeth, the right with four; lobes of thoracic and abdominal segments not well defined; anal orifice consisting of a longitudinal cleft, on either side with a raised oval lobe; apex ventrad with an oblique area on either side, of dense setae; antennæ 4-jointed, the second and third joints long, the fourth very small; latero-cervical shield consisting of an elongate, transverse area far above the thoracic peritreme .. .. = No. 349.

Body widest at base of apical abdominal segment; caudal legs longer than either first or second; thoracic peritreme open along caudal margin; mandibles curved, the penicellus present; lacinia and galea not distinctly separated; spiracles closed .. .. — (3).

(3) Body short and stout, the head much narrower, not conspicuous, partly retracted; legs small; antennæ 4-jointed .. .. = (4).

Body not short and stout, the head not much narrower, conspicuous, not retracted; legs not small .. .. = (5).

(4) Venter of abdomen at apex with a naked elliptical central space, without special delimiting setæ; size medium .. .. = *Cacachroa decorticata.*

Venter of abdomen at apex with a narrow elliptical path, open caudad, and bounded on either side by a row of about fourteen short, stout, black setæ; size medium-small .. .. = *Cetonid* sp. No. 46.

(5) Antennæ apparently only 3-jointed; apex of antennæ with numerous long scattered setæ.

Size small; apical abdominal segment ventrad without scattered setæ, but with a long, oblique row of very close, short, stout setæ running almost entire length of segment and approaching each other caudad; anal orifice straight; epicranium practically smooth; left mandible with two small acute inner teeth, the right with one, no small tooth near the retinaculum; second and third antennal joints long, the appendix long, half as long as joint 3 but not projecting beyond apex of the joint .. .. = No. 539.

Antennæ plainly 4-jointed; apex of antennæ without distinct setæ .. = (6).

(6) Anal orifice forming a transverse cleft, somewhat distant from the apex and on the dorsum of the abdomen, the abdomen squarely truncate at apex.

Size small; head smooth; apex of abdomen ventrad smooth, with a transverse line of short fine setæ; anal orifice straight; second antennal joint as long as other three united; epicranial sclerite with about two setæ on either side of meson in centre, the sclerite otherwise naked .. .. .. = No. 607.

Anal orifice not impressed, situated at extreme caudad, the apex pointed = (7).

(7) Anal orifice forming a straight, or nearly straight, transverse slit, without a channe. joining it at meson from venter; head sometimes punctate or wrinkled; size medium to very large, never small; apex of abdomen ventrad with or without a definite formation of setæ .. .. = (8).

Anal orifice triangular, the apex caudad, with a median channel joining its apex from venter; head always smooth, or practically so; apex of abdomen always with a definite formation of setæ; size medium small to very small, never large = (18).

(8) Head punctate; apex of abdomen ventrad without a definite naked path bounded by a definite row of setæ; small tooth near (distad of) retinaculum always present; second lobe of abdominal segments two to six smallest, longest at the meson; prothorax not divided into distinct lobes dorsad .. .. = (9).

Head never punctate, rarely transversely wrinkled, usually smooth; apex of abdomen ventrad often with a naked path bounded by a definite row or rows of setæ; small tooth near (distad of) retinaculum often absent; prothorax dorsad divided into two or more distinct lobes; second lobe of abdominal segments 2 to 6 shortest, longest at the meson .. .. = (12).

(9) Second lobe of anal segment dorsad with most of its surface somewhat raised and bounded by an oval suture; epicranial sclerite with a row of setæ near its cephalic margin and setæ scattered over its surface; second antennal joint with two setæ.

Size rather large; antennal joints not slender, the second longest, not twice as long as wide; peritremes distinctly open; latero-cervical shield somewhat wider than greatest length (cephalo-caudad), its cephalic margin strongly convex, the two caudal sides of about equal length, with about five setæ along its dorso-caudal margin; pubescence rather sparse .. .. = No. 71.

Second lobe of anal segment dorsad, plain; epicranial sclerite wholly without setæ; antennae wholly naked .. .. = (10).

(10) Peritremes not distinctly open; legs not distinctly increasing in size caudad; whole body with very dense pubescence; latero-cervical shield with at least several setæ along its margin; size very large; colour slaty blue; pubescence brownish red .. .. = *Xylotrupes australicus*.

Peritremes distinctly open; legs distinctly increasing in size caudad; body with much sparser pubescence, quite sparse on thorax dorsad; latero-cervical shield with only one or two setæ along its margin; size medium to medium large = (11).

(11) Epicranial sclerite well separated from the clypeus; latero-cervical shield with two setæ, one cephalad, one caudad; second antennal joint not twice as long as greatest width; body more or less bluish throughout; thorax dorsad with more setæ; size medium .. .. = No. 678.

Epicranial sclerite not well separated from the clypeus; latero-cervical shield with only one seta, on its caudal margin; second antennal joint over twice as long as greatest width; thorax not showing bluish, also the cephalic abdominal segments; thorax dorsad with less setæ; size medium large = *Dasygnathus australis*.

(12) Apex of abdomen ventrad *with* a naked path bounded by definite setæ; head never strongly wrinkled; small tooth near (distad of) retinaculum always absent; latero-cervical shield reaching much below thoracic peritreme (except in No. 89) .. .. = (13).

Apex of abdomen ventrad *without* a naked path bounded by definite setæ; head rarely strongly wrinkled; small tooth near (distad of) retinaculum sometimes present; latero-cervical shield never reaching below thoracic peritreme = (15).

(13) First antennal joint without setæ, the third with two setæ: cephalic margin of epicranial sclerite *without* a row of setæ; first joint of maxillary palpus with three setæ; latero-cervical shield not reaching ventrad farther than a line drawn cephalo-caudad through centre of thoracic peritreme, its cephalic margin *without* setæ, the angle formed by the two caudal sides, acute; prothorax dorsad with *three* lobes; body uniformly opaque creamy yellow.

Size medium; thorax dorsad with scattered setæ; head almost smooth, as in *albohirta*; peritremes much open; anal path not well defined, short, with a *straight* row of about 14 delimiting setæ on either side, the setæ fine and short = *Lepidiota* sp. No. 89.

First antennal joint with from four to seven setæ, the third *without* setæ; cephalic margin of epicranial sclerite *with* a row of long setæ; first joint of maxillary palpus without setæ; latero-cervical shield reaching ventrad much below thoracic peritreme, its cephalic margin *with* setæ, the angle formed by the two caudal sides, obtuse; prothorax dorsad with *two* lobes; at least apical abdominal segment bluish .. .. = (14).

(14) Size medium; epicranial sclerite very finely rugulose or coriaceous; peritremes much open; anal path short, with a *convex* delimiting row of about twelve setæ on either side, the setæ rather long, meeting across meson of path; margins of mandibles *not* uniformly converging toward apex = *Lepidiota* sp. No. 377.

The same but anal path with twenty setæ on either side, these denser, shorter, not meeting across meson of path .. .. .. = *Lepidiota* sp. No. 215.

Size very large; epicranial sclerite finely densely rugose or coriaceous; peritremes almost closed; anal path rather short, with a *straight* delimiting row of about fourteen setæ on either side, these meeting across meson of path; margins of mandibles not uniformly converging toward apex = *Lepidiota* sp. No. 45.

Size large; epicranial sclerite finely alutaceous, the lines feebly impressed and appearing as faint cracks; peritremes almost closed; anal path long, with a *straight* delimiting row of about from 24-26 fine, short, well-defined setæ on either side; margins of mandibles uniformly converging toward apex = *Lepidiota albohirta*.

Size medium large ; epicranial sclerite as in *albohirta* ; peritremes distinctly open ; mandibles as in *albohirta* ; anal path rather long, with curved margins, the delimiting setæ well defined, rather long and stout, in about four rows .. .. = *Lepidiota frenchi*, No. 533.

Very similar to *frenchi* but peritremes almost closed ; mandibles as in No. 377 ; anal path shorter and with less setæ, these longer = *Lepidiota* sp. No. 666.

(15) Cervix and segmental incisions armed with fine black setæ or teeth ; apical antennal joint barely as long as penultimate ; antennæ wholly naked.

Head not wrinkled ; pubescence of body moderately dense ; mandibles with a small tooth near (distad of) retinaculum ; size medium large .. .. .. = *Anoplognathus boisduvali*.

Cervix and segmental incisions unarmed ; apical antennal joint longer than penultimate, the second joint with three setæ in centre dorsad .. .. = (16).

(16) Head strongly, more or less transversely, wrinkled ; pubescence moderately dense ; epicranium distinctly convex.

Mandibles *without* a tooth near (distad of) the retinaculum ; size medium .. = No. 576.

Head smooth or practically so ; pubescence very dense ; epicranium not distinctly convex .. .. = (17).

(17) Size medium large ; mandibles *without* a tooth near (distad of) the retinaculum ; head larger .. .. = *Calloodes greyanus*, No. 655.

Size medium ; mandibles *with* a tooth near (distad of) the retinaculum ; head smaller .. .. = *Repsimus æneus*, No. 434.

(18) Apex of abdomen ventrad with a flat, curved, transverse bow of setæ, with a naked path caudad of it.

Size small ; setæ in bow about twenty, close, short, rather fine ; antennæ naked except for a single seta on second joint ; epicranial sclerite with a single seta on either side of meson in centre, otherwise naked .. .. = No. 609.

Apex of abdomen ventrad with a V-shaped row of setæ, the apex cephalad.

Size moderately small ; setæ in V very fine, not dense ; epicranium wholly naked ; second antennal joint with one seta dorsad, and one ventrad, the antennæ otherwise naked .. .. = No. 653.

Apex of abdomen ventrad with a Y-shaped row of short setæ, the shaft double, thus  ; epicranial sclerite without setæ ; second antennal joint with one seta at base ventrad, antennæ otherwise naked.

Shafts of the Y parallel ; setæ in Y scattered, about fifteen on either side, the shafts and branches longer ; size small .. .. .. = No. 646.

Shafts of the Y diverging caudad, the setæ rather dense, about twenty on either side, the shafts and branches shorter ; size moderately small = No. 667.

Apex of abdomen ventrad with a curved U of rather dense setæ, this open caudad.

Cephalic margin of epicranial sclerite with only one seta on either side of meson, the row behind this consisting of two setæ on either side of meson ; body not so slender ; size rather small.

Anal row of setæ in a broad horseshoe ; no longer or as long as its greatest width ; setæ very distinct and closely set together, the lateral sides of the horseshoe slightly converging caudad .. .. .. = No. 650.

Cephalic margin of epicranial sclerite with a row of setæ, behind this with a row of scattered setæ ; body more slender ; size rather larger.

Anal row of setæ in a broad horseshoe, wider than long, the lateral sides converging and nearly touching caudad, the setæ longer and denser = No. 671.

Anal row of setæ not so rounded cephalad, its lateral margins not converging caudad, distinctly longer than its greatest width, the setæ shorter and less dense .. .. = No. 587.

Descriptions of Larvæ.

Based on the full description of Stage III of *Lepidiota albohirta*. Waterhouse.

XYLOTRUPES AUSTRALICUS Thomson.

Stage III.—Greatest length at stretch, 83 mm.; width at base of anal segment, 20 mm.; length in normal curved position, 41 mm.; thickness, 20 mm.; width of head, 12 mm.; length to apex of labrum, 10·5 mm.

Colour creamy white, the last abdominal segment slaty or blue-grey, the whole body more or less bluish (this due to the contents of the intestines showing through); head dark reddish brown, also the peritremes, the stigmata somewhat paler, black in extreme centre; legs and laterocervical shield golden brown; antennæ concolorous with the head, mandibles black; maxillæ (except cardo) golden brown; maxillary and labial palpi concolorous with the head.

Form curved, the body cylindrical, pointed obtusely, caudad; dorsal surface convex, the ventral flattened, margined by a longitudinal fold and a series of segmental convexities; body transversely wrinkled or folded. Legs prominent. Epicranium punctate, the punctures scattered, small, largest toward the clypeus, becoming very small and indistinct far laterad and caudad; without pubescence except for scattered setæ along its lateral and caudal margins. Clypeus punctate, the punctures largest caudad but much smaller than the adjacent epicranial punctures; with a pair of setæ on either side nearer its cephalic than caudal margin and a single seta on either side of meson, cephalic margin; clypeus nearly two and a-half times as wide as long. Labrum wrinkled or finely rugose and with indistinct scattered punctures; cephalic margin with eyelash-like setæ, the caudo-lateral corner with a rather scattered clump of bristles. Antennæ 4-jointed (not counting the short, conical bulla); almost as long as the mandibles; filiform, the first three joints widening toward apex; the second the longest, a little longer than first or third which are subequal; appendix short, tubercular; fourth joint conical at apex, and slightly shorter than third, with the usual pustule-like spot; second joint not thrice as long as its greatest width; antennæ wholly naked. Mandibles distinctly longer than width at base (excluding retinaculum); the apex bidentate, the outer tooth broad, obliquely truncate, its outer angle acute, the inner tooth smaller and rounded but more developed than usual; a dorso-median ridge runs from centre of inner tooth to base of mandible, outside which is a groove running for three-fourths its length from base, the groove with a single seta in centre apically and bounded distad by a second ridge; below this ridge a rather broad sulcus with about twelve scattered setigerous punctures; a single long bristle at base of inner apical tooth, a small third tooth is present between the apical teeth and the retinaculum but closer to the former, this broad on left mandible, much smaller on right; surface shining, smooth, the teeth alutaceous. Retinaculum from dorsal aspect, left mandible 4-dentate, the proximal tooth thorn-like and erect, the others obtuse, the distal one massive, the penicellus in a short semicircle at proximal margin of retinaculum, nearly erect; right mandible, the retinaculum with two obtuse teeth, the proximal one massive, the penicellus arising from the proximal face of the proximal tooth; from ventral aspect, retinaculum appearing as one large tooth on left mandible, about three on right. Cardo of *maxilla* not much wider than long; the stipes compressed laterally, with a distinct ridge dorsad, this ridge armed with a row of minute teeth;

lacinia and galea apparently one stout piece with a longitudinal fold, with three stout black teeth at apex of lacinia, and one at apex of galea, this last the largest; this piece with setæ of varying size; the stipes with setæ around base of bulla and a few ventrad; galea attaining distal palpal point, the lacinia somewhat shorter. Maxillary palpus 4-jointed, the first joint (palpigerous stipes) short; second and third subequal, somewhat longer than wide, the fourth pointed-conical at apex, and fully two and a-half times as long as wide, the third ventrad with a single seta on each side distad. Mentum fleshy, a little wider than long, laterad and cephalad with long setæ, these much shorter caudad, very short medially *Labial palpus* 2-jointed, the first joint a little wider than second, somewhat wider than long, second over one-half longer than wide, the palpus naked.

Stigmata circular, apparently closed; the peritremes circular, the thoracic pair larger than the abdominal ones, the thoracic pair irregularly circular, almost flat along caudal margin; abdominal peritremes closed except for a narrow slit in the centre of the rather flattened cephalic margin, this slit in centre of caudal margin of thoracic pair; a small oval spot in folds of last two thoracic segments. Thorax subquadrate, somewhat wider than the head, prothorax dorsad *without* a transverse incision, the meso- and metathorax each with two deep incisions and thus with three dorsal lobes. Latero-cervical shield not much wider than greatest length (cephalo-caudad), its cephalic margin almost regularly gently, convex, its caudal margin forming the two sides of an obtuse angle, the side nearest venter much shorter than the other; without clothing except for long setæ along the longer caudal margin and ventral third of cephalic margin. Cervix unarmed. *Legs* guarded cephalad and laterad by chitinised plates, these relatively smaller than in *Lepidiota albohirta*; legs only slightly increasing in size caudad, the hind femur not greatly larger than the cephalic one; tarsus of two posterior pair of legs as long as its femur, in the cephalic pair longer; spine on second tarsal joint shorter and stouter than in *albohirta*, its apex curved, otherwise the legs agree with those of *albohirta*. Abdomen cylindrical, somewhat over thrice length of thorax, the last segment over twice the length of the others; incisions of segments as in *albohirta*, but the second lobe is smallest, longest at the meson. Clothing of reddish or ginger brown, epicranial sclerite without pubescence; on body, pubescence long and dense laterad and especially so on the segmental convexities. Dorsal aspect: Prothorax with rather dense, long pubescence, not arranged in regular rows; first lobe of mesothorax the same mesad, the second the same laterad, but without clothing mesad, the third with one irregular row continued its entire width; metathorax with clothing similar to mesothorax; first lobe of first abdominal segment with dense, long pubescence, the second with one row mesad, dense laterad, also with a few very short stout hairs; lobes of remaining segments similar to second lobe of first segment, except that there are more rows than one mesad, and the stout setæ predominate on apical segments mesad so that on apical segments the pubescence is less dense and only scattered long setæ are present, extreme apex of abdomen with dense long setæ. Ventral aspect, segments of thorax and abdominal segments 1-8 with transverse (cephalo-caudad) areas of long setæ, also first lobe of last segment, these much denser cephalad, rather sparse caudad; second lobe of anal segment with scattered setæ, the apex with rather dense, short, stout setæ followed at extreme apex by dense, long setæ, no definite marked formation of setæ present.

Stage II.—Greatest length, 47 mm.; width, 16 mm.; length in natural curved position, 26 mm.; thickness, 15 mm.; width of head, 7 mm.; length to apex of labrum, 6·5 mm.

Differing markedly from Stage III. in that the pubescence is not nearly so distinct, being shorter and less dense on the body and of a lighter colour; the peritremes are distinctly open, the slit thus being wider; the head is comparatively much narrower and not so dark in colour; second antennal joint not twice as long as greatest width; dorsal groove of mandible without a seta and no seta at base of second apical tooth. Freshly molted specimens have the pubescence longer and the body colour more bluish. The stage bears a very decided superficial resemblance to Stage III. of *Dasygnathus australis*.

Stage I.—Greatest length, 23 mm.; width, 6·5 mm.; length in natural curved position, 13 mm.; thickness, 6 mm.; width of head, 4·25 mm.; length to apex of labrum, 3·75 mm. Pubescence sparser than in Stage II.; coloured portions of body still lighter.

DASYGNATHUS AUSTRALIS Boisd.

Stage III.—Creamy or yellowish, opaque, the last abdominal segment blue; head and peritremes reddish brown, also the antennæ (the joints ringed with white at apex and with the usual white spots on apical joint); mandibles black, except at base; latero-cervical shield golden yellow, the legs and palpi paler yellow. Greatest length when extended, 38 mm.; width at base of anal segment, 11 mm.; length in normal curved position, 18 mm.; thickness, 10 mm.; width of head, 7 mm.; length to apex of labrum 6·75 mm.

Epicranium punctate as in *Xylotrupes*, the punctures rather finer and denser, its lateral and caudal margins with only a very few scattered setæ. Clypeus apparently with only one seta on each lateral margin. Labrum with a single hair on either side in centre and one in each caudo-lateral and cephalo-lateral angles, the cephalic margin with the usual eye-lash-like setæ. Antennæ much as in *Xylotrupes* but the second joint is one-half longer than either first or third, the last joint as long or slightly longer than third. Mandibles slightly longer than width at base (including retinaculum), very similar to those of *Xylotrupes* but the third tooth (near retinaculum) not so obtuse, not indicated on right mandible. Retinaculum on left mandible tridentate dorsad, the proximal thorn-like tooth not present, the distal tooth massive, all three obtuse; instead of the fourth (proximal) tooth there is a fleshy conical projection with a clump of short, stout setæ at its apex; penicellus semicircular and arising at proximal base of this projection. Retinaculum on right mandible dorsad about tridentate, the proximad tooth massive, all obtuse; penicellus in a clump proximad on proximal tooth, the conical projection absent. Apical joint of maxillary palpus barely twice as long as wide. Stout, black teeth at apex of lacinia and galea not so distinct, only three present, the inner two small. Thoracic peritreme distinctly open in centre of flat caudal margin, the abdominal ones in centre of cephalic margins. Latero-cervical shield one-half wider than greatest length (cephalo-caudad), its cephalic margin nearly straight, the two caudal sides of almost equal length, wholly without clothing, except for one long seta at dorso-caudal angle on caudal margin. Legs distinctly increasing in size caudad, the hind femur over one-half longer than cephalic femur; similar to *Xylotrupes*. Incisions of body segments as in *Xylotrupes*. Clothing of body

golden yellow; pubescence densest laterad and on segmental convexities, but nowhere dense; dorsal aspect, prothorax with three setæ on either side of meson and with a clump of setæ, not very dense, below cervical shield; first lobe of mesothorax with two long setæ on either side of meson, the second with two on either side farther laterad and a few below cervical shield, the third without setæ; metathoracic lobes with similar clothing to those of mesothorax; all setæ on thorax long; first lobe of first abdominal segment with four long and four very short, stout setæ, second lobe with an irregular row of long and short setæ; lobes of segments 2-6 with rather dense, short, stout setæ, and a few scattered long setæ; 7 and 8 without pubescence except for one row of very scattered long setæ along caudal margin; first lobe of anal segment similar, the second with long setæ scattered over its surface and at apex with rather dense long and short setæ. Venter of body; segments of thorax with two or three transverse rows of long setæ in centre; abdominal segments 1-5 with one row of scattered long setæ 6 and 7 with one seta on either side of meson and two laterad; 8 the same but with two setæ on either side of meson; first lobe of anal segment with about ten long setæ in a row, the second lobe (except at base) with rather short, stout setæ, followed at extreme apex by longer setæ. In other respects similar to *Xylotrupes*.

Stage II.—Greatest length, 24 mm.; width in normal curved position, 12 mm.; thickness, 6·5 mm.; width of head, 5·10 mm.; length to apex of labrum, 4·8 mm.

Second lobe of mesothorax with only one seta on either side of meson; first lobe of metathorax similar, the second with only one farther laterad; first lobe of first abdominal segment with only one seta on either side of meson, the second with a row of scattered long setæ, consisting of about four on either side; 2-6 with setæ similar to but not so dense as in Stage III.; 7 and 8 with one row at caudal margin of six long setæ, also first lobe of anal segment, the apex of second lobe with only scattered long and short setæ; venter of abdominal segments with only one or two long setæ, the setæ at extreme apex not so dense as in III.; peritremes more open; otherwise similar to Stage III.

No. 678.

Stage III.—Greatest length when extended, 34 mm.; width at base of anal segment, 9 mm.; length in natural curved position, 17 mm.; thickness, 8 mm.; width of head, 4·75 mm.; length to apex of labrum, 4·50 mm.

Very similar to Stage III. of *Dasygnathus australis*, but the body slender and more bluish, the head distinctly smaller; epicranial sclerite well separated from the clypeus and with a series of small notches along the cephalic margin, about five; second antennal joint not twice as long as greatest width (distinctly more so in *Dasygnathus*); the last joint distinctly though not much longer than preceding; prothorax dorsad with *four* setæ on either side of meson; first lobe of mesothorax with *three* setæ on either side, the second with *six* on either side farther laterad, the third with *one* on either side at meson; metathorax similar to mesothorax, but third lobe with about *three* setæ on either side; first lobe of first abdominal segment with four long and two short setæ; segments 6-8 ventrad with one row of long scattered setæ; latero-cervical shield with an additional seta in centre of cephalic margin, otherwise about similar.

Stage II.—Greatest length, 19 mm.; width, 5 mm.; length in normal curved position, 9·5 mm.; thickness, 4·5 mm.; width of head, 3 mm.; length to apex of labrum, 2·80 mm.

Stage I.—Greatest length, 10 mm.; width, 3 mm.; length in normal curved position, 5 mm.; thickness, 2·75 mm.; width of head, 1.5 mm.; length to apex of labrum, 1·40 mm.

No. 71.

Stage III.—Greatest length when extended, 44 mm.; width at base of anal segment, 14 mm.; length in natural curved position, 24 mm.; thickness, 11 mm.; width of head, 5 mm.; length to apex of labrum, 5 mm.

Similar in many respects to *Dasygnathus*. Second lobe of anal segment dorsad with most of its surface raised and bounded by an oval suture. Head with small scattered punctures; epicranial sclerite with a row of setæ near its cephalic margin and with long setæ scattered over its surface, also the epicranium; clypeus with two setæ on either side of meson and two far laterad. Antennal joints not slender, the second longest, not twice as long as wide, a little longer than the third, the first distinctly shorter; second joint with two setæ dorsad, the rest naked. Mandibles without the second apical tooth, the small tooth just laterad of the retinaculum present, barely indicated in right mandible. Peritremes distinctly open. Latero-cervical shield somewhat wider than greatest length (cephalo-caudad), its cephalic margin strongly convex, the two caudal sides of about equal length and with about five setæ along its dorso-caudal margin. Pubescence rather sparse but denser than in *Dasygnathus,* the apex of abdomen ventrad with close stout setæ.

No. 349.

Stage III.—Greatest length when extended, 35 mm.; width at thorax, 8·5 mm.; length in natural curved position, 14 mm.; thickness, 7·5 mm.; width of head, 6·10 mm.; length to apex of labrum, 6 mm.

Body widest at the thorax, slightly tapering toward apex of abdomen. Middle pair of legs somewhat longer than either first or third. Peritremes flattened, very open, both thoracic and abdominal ones open along *cephalic* margin, the abdominal ones greatly decreasing in size caudad, very small on segments 6-8. Epicranium practically smooth, polished, with a very few scattered pin-punctures and a very few scattered setæ; cephalic margin of epicranial sclerite with one seta on either side of meson, also a small oval fovea against either lateral margin in centre (caudo-cephalad); clypeus with a few scattered setæ; labrum as usual. Outer side of mandible quite straight, not at all curved; left mandible with five acute teeth, the proximal ones smallest, the retinaculum consisting of one outer tooth and one long obtuse proximal one, the penicellus *absent*; right mandible with four teeth, less acute, the retinaculum 4-dentate, the basal tooth obtuse, the outer three acute. Lacinia and galea distinctly separated, each with a stout curved spine at apex, the galea a little longer than lacinia. Maxillary and labial palpi about as usual, the third joint of former with one seta at base and one at apex dorsad. Lobes of thoracic and abdominal segments, especially the latter, not well defined. Thorax, apical abdominal segments and all body ventrad with scattered setæ; abdominal segments 1-6, dorsad, with very dense minute teeth or setæ. Anal orifice consisting of a deep

longitudinal cleft, on either side with a raised oval lobe. Apex of abdomen ventrad with an oblique well-defined area on either side, of very dense shortish setæ. Antennæ 4-jointed, first joint rather short; second long and slender and with about six setæ dorsad; third as long as second, or nearly so, with about three setæ near its base dorsad; fourth minute, situated in centre at apex of preceding joint. Latero-cervical shield consisting of a very narrow, elongate (dorso-laterad) area, far above (dorsad of) thoracic peritreme. Spiracles with an open, transverse (dorso-laterad) slit. Colour slaty blue, due to contents of food canals showing through; first four or five dorsal convexities of segments folds, white; peritremes rust red; head golden yellow, the clypeus and labrum darker; the mandibles red, black at apex; antennæ red brown; legs golden yellow.

CALLOODES GREYANUS White. **No. 655.**

Stage III.—Greatest length, 42 mm.; width at base of anal segment, 12 mm.; length in natural curved position, 21 mm.; thickness, 10 mm.; width of head, 6 mm.; length to apex of labrum, 5·5 mm.

Very similar to *Anoplognathus boisduvali* but mandibles shorter, distinctly shorter than length of epicranium (in *Anoplognathus,* as long or longer than epicranium); antennæ somewhat shorter, when viewed from above, the apical joint longer than preceding (barely as long in *Anoplognathus*), the second joint with three setæ in centre dorsad, close together (antennæ wholly naked in *Anoplognathus*); mandible with the second apical tooth well defined, the tooth just laterad of retinaculum not at all indicated; cervix unarmed, also the segmental convexities; pubescence much denser, very dense, of a rich reddish hue.

Stage II.—Greatest length, 28 mm.; width at base of anal segment, 8 mm.; length in normal curved position, 14 mm.; thickness, 7 mm.; width of head, 4·25 mm.; length to apex of labrum, 3·90 mm.

Left mandible with *two* small apical teeth inside (proximad of) the outer one.

Stage I.—A bred larva, 48 hours old, has the two inner apical teeth well defined and acute, but no trace of the tooth near the retinaculum. Width of head, 2·75 mm.; length to apex of labrum, 2·50 mm.

REPSIMUS AENEUS Fabr. **No. 434.**

Stage III.—Greatest length when extended, 32 mm.; width at base of anal segment, 8 mm.; length to apex of labrum, 4 mm.

Left mandible with a distinct tooth just laterad of the retinaculum, not well defined on right mandible. Otherwise apparently the same as *Calloodes greyanus.*

Stage II.—Greatest length, 25 mm.; width, 6 mm.; length in natural curved position, 12 mm.; thickness, 5 mm.; width of head, 3 mm.; length to apex of labrum, 3 mm.

Stage I.—Width of head, 1·50 mm.; length to apex of labrum, 1·50 mm.

Stages II. and I. with two small teeth within apical tooth.

This species runs very close to *Calloodes greyanus* but the head in all stages is relatively much smaller and the tooth just distad of the retinaculum is present, at least in the left mandible.

No. 576.

Stage III.—Greatest length when extended, 40 mm.; width at base of anal segment, 10 mm.; length in curved natural position, 20 mm.; thickness, 8·5 mm.; width of head, 5 mm.; length to apex of labrum, 5 mm.

Epicranium strongly, more or less transversely, rugulose or wrinkled, except along its caudal and lateral margins where it is smooth, distinctly more convex than in the related species, the epicranial sclerite apparently without setæ. Pubescence about as dense as in *Anoplognathus*, except on abdominal segments where it is much sparser, the setæ throughout shorter than in that species, more especially so on segmental convexities. Mandibles and antennæ very similar to *Calloodes greyanus*. Cervix and segmental sutures unarmed.

Closely related to *Anoplognathus boisduvali*, *Calloodes greyanus*, and *Repsimus æneus*.

Stage II.—Greatest length, 27 mm.; width, 6 mm.; length in natural curved position, 12 mm.; thickness, 5 mm.; width of head, 2 mm.; length to apex of labrum, 2 mm.

Stage I.—Greatest length, 15 mm.; width, 3·25 mm.; length in normal curved position, 7 mm.; thickness, 2·75 mm.; width of head, 2 mm.; length to apex of labrum, 2 mm.

Left mandible in all stages without a trace of the second inner tooth (not the tooth near retinaculum) present in Stages I. and II. of *Calloodes greyanus* and *Repsimus æneus*.

No. 539.

Stage ?.—Greatest length when extended, 20 mm.; width at base of anal segment, 4·75 mm.; length in natural curved position, 9 mm.; thickness, 4 mm.; width of head, 2·75 mm.; length to apex of labrum, 2·40 mm.

In general appearance rather similar to the small species No. 650, and allies. Anal orifice forming a transverse slit. Whole body dorsad with long dense pubescence, the basal abdominal segments also with very short, stout setæ; venter of body with scattered setæ. Epicranium practically smooth, with scattered setæ, the cephalic margin of epicranial sclerite with a row of setæ, clypeus and labrum about as usual. Mandibles about as usual, the left with two small acute teeth, the right with one; no small tooth near the retinaculum. Apical abdominal segment ventrad without scattered setæ but with a long, oblique row of very close, short, stout setæ on either side, rather far laterad, running nearly the whole length of the segment, somewhat approaching each other caudad. Antennæ 3-jointed; first joint short, second long and slender with two setæ dorsad on its apical half; third nearly as long as second, its apex conical, with numerous scattered setæ (nearly twenty) on its apical half, the appendix very long, half as long as the joint but not projecting beyond its apex; apparently no fourth joint.

LEPIDIOTA FRENCHI Blackburn. **No. 533.**

Stage III.—Greatest length at stretch, 41 mm.; greatest width (at base of anal segment), 10 mm.; length in natural curved position, 18 mm.; thickness, 8 mm.; greatest width of head, 6 mm.; length to apex of labrum, 5·5 mm.

Very similar to *albohirta* but will differ as follows:—Stigmata much larger in comparison to the peritremes the widest portion of the peritreme not half as wide as the stigmata (nearly as wide in *albohirta*), the peritremes distinctly open, the opening slit wider than long (peritremes scarcely open in *albohirta*, the opening slit very narrow, many times longer than wide); apex of abdomen ventrad with a naked longitudinal path, with convexed margins, delimited by about four rows of rather short, stout setæ, these overlapping; the scattered setæ being all round this path.

Stage II.—Greatest length, 31 mm.; width, 8 mm.; length in natural curved position, 13 mm.; thickness, 6·5 mm.; width of head, 4 mm.; length to apex of labrum, 3·75 mm.

Same as Stage III. but colour throughout paler; pubescence somewhat sparser.

Stage I.—Greatest length, 17 mm.; width, 4·5 mm.; thickness, 3·25 mm.; length in normal curved position, 8 mm.; width of head, 2·10 mm.; length, 2 mm.

Same as Stage II. But pubescence still somewhat sparser.

LEPIDIOTA Sp. **No. 377.**

Stage III.—Greatest length at stretch, 32 mm.; width at base of anal segment, 8 mm.; length in natural curved position, 14·5 mm.; thickness, 6·75 mm.; width of head, 5 mm.; length to apex of labrum, 4·25 mm.

Will differ from *albohirta* as follows:—Epicranial sclerite very finely rugose or coriaceous (in *albohirta*, the sclerite is finely alutaceous, or irregularly reticulate, the lines feebly impressed and appearing as cracks); setæ at its cephalic margin very fine, slender and long, also all setæ on epicranium; in *albohirta* the distal tooth of the retinaculum on left mandible is massive, without acuteness and with only a faint indication of being divided into two teeth; in this species the two teeth are distinct and acute; ventral aspect of mandibles smooth (very finely transversely striate in *albohirta*); margins of mandibles not uniformly converging towards apex, the mandible no wider at nearly one-half its length from apex than at the apex of the inner tooth, or teeth since it is plainly double (in *albohirta*, margins of mandible uniformly converging towards apex, and thus much wider toward base than toward apex the inner teeth obtuse and only one distinctly defined); peritremes much open, more so than in No. 533; apex of abdomen ventrad with a naked path, delimited by one row of about twelve short setæ on either side, these setæ meeting across the naked path, which has its margins gently convex, the scattered setæ of anal segment all around this area (in *albohirta* none cephalad); pubescence of body rather sparser, more noticeably so on ventral aspect of abdominal segments 1-7; body more bluish, nowhere creamy or milky white, the coloured parts paler; first antennal joint with four setæ dorsad; teeth on apex of lacinia and galea longer and somewhat curved at apex.

Stage II.—Greatest length, 22 mm.; width, 5·5 mm.; length in curved natural position, 9·5 mm.; thickness, 4 mm.; width of head, 3·10 mm.; length to apex of labrum, 3 mm.

LEPIDIOTA Sp. **No. 666.**

Stage III.—Greatest length, 38 mm.; width at base of anal segment, 11 mm.; length in natural curved position, 18 mm.; thickness, 9 mm.; width of head, 6 mm.; length to apex of labrum, 5·5 mm.

Almost exactly similar to No. 533, but anal path shorter, the delimiting setæ longer almost meeting across path, with about forty (or less) setæ on either side, the cephalic third with only one row on either side (in 533 delimiting setæ short, not nearly meeting across path, with about fifty or less [but more than forty] setæ on either side, the cephalic third with two or more irregular rows on either side); peritremes almost closed; margins of mandibles not uniformly converging towards apex, the mandible no wider at nearly half its length from apex than at the apex of the inner tooth (or teeth, since it is plainly double), in 533, margins of mandible uniformly converging towards apex, and thus much wider towards base than toward apex. Retinaculum in both species with the outer tooth dorsad divided into two obtuse teeth. Mandible shaped as in No. 377. Otherwise apparently the same as No. 533.

Stage II.—Greatest length, 26 mm.; width, 7 mm.; length in natural curved position, 12 mm.; thickness, 6 mm.; width of head, 4 mm.; length to apex of labrum, 3·75 mm.

LEPIDIOTA Sp. **No. 215.**

Stage III.—Similar to No. 377 in size and all respects but will differ as follows:—Anal path longer, the sides more distinctly convex, the delimiting setæ not meeting across meson of path, these setæ denser and shorter, about twenty on either side (never more than twelve in No. 377), and very distinct, being much darker than surrounding setæ.

Stage II.—Similar in size, &c., to corresponding stage of No. 377. Although very similar to No. 377, the characteristics appear to hold.

LEPIDIOTA Sp. **No. 89.**

Stage III.—Greatest length at stretch, 30 mm.; width at base of anal segment, 9 mm.; length in natural curved position, 12 mm.; thickness, 5·5 mm.; width of head, 5 mm.; length to apex of labrum, 4·75 mm.

Similar to *albohirta* but will differ as follows:—First antennal joint short, one-half longer than wide and barely more than half as long as second, without setæ, the second with one seta dorsad and three ventrad, the third with two setæ at half its length ventrad (in *albohirta*, first antennal joint nearly thrice as long as wide and distinctly more than half as long as second, with five [seven?] setæ dorsad, the second with only one seta dorsad in centre, the third naked); cephalic margin of epicranial sclerite without a row of setæ; left mandible with two small yet distinct teeth, inside apical tooth, first joint of maxillary palpus with three setæ dorsad (naked in *albohirta*); stigmata and peritremes about as in No. 533; latero-cervical shield no more than twice as wide as greatest length (cephalo-caudad), naked except for three setæ along its caudo-dorsal side, not reaching ventrad farther than a line drawn cephalo-caudad through centre of thoracic peritreme, the angle formed by the two caudal sides, acute (in *albohirta*, the shield fully thrice as long as greatest width, its cephalic margin also with long rather dense setæ, reaching ventrad much below peritreme, the angle formed by the two caudal sides very obtuse); first lobe of prothorax with only two setæ on either side, the second with three on either side, the third naked,

the prothorax thus with three lobes of which 1 and 2 are longest at meson, the latter not present laterad (in *albohirta,* prothorax with only two lobes, both with two or more irregular rows of setæ of various lengths); first lobe of mesothorax with about three setæ on either side of meson, the second with none at meson but with three on either side farther laterad, not counting dorsum of segmental convexity, the third with one seta on either side of meson (in *albohirta,* first lobe with two or three rows of various-lengthed setæ, the second with two or three rows laterad, none at meson, the third with one continued row); first lobe of metathorax with four setæ on either side of meson, otherwise similar to mesothorax; abdominal segments similar to those of *albohirta* but apical three segments with fewer scattered setæ; venter of body with fewer setæ; apex of anal segment with the anal path not clearly defined, with only about fourteen delimiting setæ in a straight row on either side (about twenty-eight in *albohirta,* the path clearly defined); body of a uniform opaque creamy yellow, the coloured parts much lighter than in *albohirta.* A species distinct in structural details and also in habits, due to its uniform yellowish colour and more flattened form.

LEPIDIOTA Sp. **No. 45.**

Stage III.—Greatest length at stretch, 75 mm.; width at base of anal segment, 17 mm.; length in natural curved position, 34 mm.; thickness, 15 mm.; width of head, 12 mm.; length to apex of labrum, 12 mm.

Very similar to *albohirta* but much larger; epicranical sclerite finely densely rugose or coriaceous, not at all reticulate, the clypeus similar, mandibles as in No. 377 but distal teeth of retinaculum on left mandible, obtuse; lacinia and galea with more teeth, these longer, more slender and somewhat curved at apex; pubescence much sparser but not as sparse as in No. 89; first antennal joint with four setæ, the second with two; anal path as in No. 89 but the delimiting setæ longer, meeting across meson of path.

No. 650.

Stage III.—Greatest length, 22 mm.; width at base of anal segment, 6 mm.; length in natural curved position, 10 mm.; thickness, 5 mm.; width of head, 4 mm.; length to apex of labrum, 3·75 mm.

Cephalic margin of epicranial sclerite without setæ. First antennal joint long and slender, not much shorter than second, this latter with one seta dorsad and three ventrad, the other joints naked. Mandibles about as in No. 377. Head smooth, shining, at the most very finely alutaceous. Pubescence about as in No. 45. Anal orifice V-shaped, the apex caudad and with a longitudinal median channel, running from apex to caudad of anal path. Peritremes and stigmata distinctly decreasing in size toward apical segments, the stigmata large, the peritremes much open. Apex of abdomen ventrad with a horseshoe-shaped area (open caudad) of about thirty stout, moderately long setæ in one row, these setæ much darker and larger than the scattered setæ surrounding them, and set very close together. Whole body showing distinctly bluish, the yellow parts paler than in *Lepidiota albohirta.*

Stage II.—Greatest length, 12 mm.; width, 3·5 mm.; length in natural curved position, 5·5 mm.; thickness, 3 mm.; width of head, 2·5 mm.; length to apex of labrum, 2·25 mm. Small species, resembling the smaller stages of the *Lepidiota.*

No. 667.

Stage III. (?)—Greatest length, 25 mm.; width, 6 mm.; length in natural curved position, 10 mm.; thickness, 5·25 mm.; width of head, 3·75 mm.; length to apex of labrum, 3·5 mm.

Differs from No. 646 in that the shafts of the Y are not parallel but somewhat oblique from each other, both the shafts and the branches shorter, their setæ dense, not scattered and with about twenty setæ altogether on either side (about fifteen in No. 646). A larger species.

No. 607.

Stage III. (?)—Greatest length, 19 mm.; width at base of anal segment, 5 mm.; length in normal curved position, 8 mm.; thickness, 4·5 mm.; width of head, 2·5 mm.; length to apex of labrum, 2·25 mm.

Anal orifice very deeply channelled, forming a transverse cleft; when viewed from the side, the abdomen rising abruptly from it, situated near apex of dorsal surface, the abdomen squarely truncate at apex, not pointed. Epicranial sclerite with about two setæ on either side of meson in centre. Second antennal joint about as long as the other three united.

No. 653.

Stage III.—Greatest length when extended, 25 mm.; width at base of anal segment, 6 mm.; length in natural curved position, 11 mm.; thickness, 5 mm.; width of head, 4 mm.; length to apex of labrum, 3·75 mm.

Epicranial sclerite wholly without setæ. Second antennal joint with one seta dorsal and one ventrad. Anal orifice with a straight incision across base, forming base of triangle (present in No. 650 but less distinct), and with an almost straight incision from lateral angle of orifice to cephalad of the median anal channel (this very faint in No. 650), with a row of very fine setæ on either side running near and parallel to these incisions, these setæ thus forming a V and much finer than those surrounding; the surrounding setæ dense. Otherwise very similar to No. 650.

No. 609.

Stage III. (?)—Greatest length, 13 mm.; thickness, 3 mm.; length in natural curved position, 6 mm.; width at base of anal segment, 3·10 mm.; width of head, 2 mm.; length to apex of labrum, 1·75 mm.

Body colour dilute milky white. Epicranial sclerite without setæ along cephalic margin, naked, except for a single seta on each side of meson in centre. Apex of abdomen ventrad with a curved bow of about twenty setæ, these setæ stouter and larger than those about them, close together, with a naked path caudad of the bow; cephalad of this bow are about two irregular rows of short scattered setæ. First antennal joint longest, a little longer than second, the second joint with a single seta dorsad at half its length.

We have examined several specimens from Gordonvale which all appear to agree in the characters given above but the specimens from Harwood Island, Clarence River, N.S.W., differ in that the second antennal joint is somewhat longer than the first, and the scattered setæ cephalad of the anal bow are larger and denser. These three specimens probably are a different species.

No. 646.

Stage III. (?)—Greatest length, 17 mm.; width at base of anal segment, 4·25 mm.; length in natural curved position, 7 mm.; thickness, 3·75 mm.; width of head, 2·25 mm.; length to apex of labrum, 2·10 mm.

White, the body showing bluish toward apex. Epicranial sclerite without setæ. First antennal joint distinctly shorter than second, the antennæ naked except for a single seta near base of second joint ventrad. Median channel at apex of abdomen ventrad, longer than usual and with a row of about six scattered setæ on either side, close together, each row at apex caudad with an oblique row of denser setæ, about nine in either row, the lines of setæ thus forming a Y with the blade double, thus  ; setæ surrounding this Y rather scattered.

No. 587.

Stage III.—Greatest length at stretch, 26 mm.; width at base of anal segment, 6 mm.; length in natural curved position, 12 mm.; thickness, 5 mm.; width of head, 3·75 mm.; length to apex of labrum, 3·5 mm.

Closely related to No. 650 but can be distinguished as follows:—Cephalic margin of epicranial sclerite with a row of rather dense setæ, behind this with a row of scattered setæ (in No. 650 cephalic margin with one seta on either side of meson, the row caudad consisting of two setæ on either side); first antennal joint much shorter than second; pubescence on thorax dorsad rather denser, anal path not so rounded cephalad, more V-shaped, its lateral margins not converging somewhat caudad, distinctly longer than its greatest width, with about twenty-four delimiting setæ altogether, the setæ not very closely set together (in No. 650, lateral margins of anal path somewhat converging caudad, no longer or not as long as its greatest width, with about thirty delimiting setæ); scattered setæ outside this path, dense, continuing up the segment cephalad for distinctly more than length of anal path (in No. 650 scattered setæ not at all dense, only about seven on either side of meson cephalad of the path, and continued cephalad for distinctly less than length of path); of a large and more slender build.

Stage II.—Greatest length, 16 mm.; width, 4 mm.; length in curved position, 7·5 mm.; thickness, 3·75 mm.; width of head, 2·5 mm.; length to apex of labrum, 2.25 mm.

No. 671.

Stage III.—Greatest length at stretch, 28 mm.; width at base of anal segment, 6·5 mm.; length in natural curved position, 13 mm.; thickness, 5 mm.; width of head, 3·50 mm.; length to apex of labrum, 3·50 mm.

Very similar to No. 587 but first antennal joint not so short, delimiting setæ of anal path denser and longer as in No. 650 and forming a broad horseshoe, wider than long, the setæ nearly meeting caudad; scattered setæ on venter of apex not so dense; body of a uniform opaque milky white. Will differ from No. 650 in its white colour, its longer and slenderer form, in bearing a row of setæ along cephalic margin of epicranial sclerite, the setæ on venter of apex denser and the setæ of anal path closer together caudad.

The characters given for these closely related species, namely, Nos. 650, 587 and 671, appear constant, several specimens or more of each species having been examined.

CETONID Sp. No. 46.

Stage III.—Greatest length at stretch, 24 mm.; width at base of anal segment, 6 mm.; length in natural curved position, 11·5 mm.; thickness, 5·5 mm.; width of head, 2 mm.; length to apex of labrum, 1·75 mm.

Apex of abdomen ventrad with a naked elongate longitudinal path, closed cephalad, open caudad, two and a-half times as long as wide, bounded by about fourteen short, stout, close setæ on either side, the rest of the segment with rather dense stoutish setæ. Peritremes more closed than in *Cacachroa decorticata.*

Stage II.—Greatest length, 16 mm.; width, 4 mm.; length in natural curved position, 8 mm.; thickness, 3·5 mm.; width of head, 1·5 mm.; length to apex of labrum, 1·30 mm.

No. 364.

Our larvæ were all in bad condition. For distinguishing characteristics, *see* table of larvæ.

Part II.—Scientific Data.

During the past three years the following data have been gathered on various phases of the life history and habits of cane beetles. The locality unless otherwise stated is Gordonvale (Cairns), Queensland, on the Mulgrave River. The data should be considerably enlarged. We are indebted to Mr. A. M. Lea, of the South Australian Museum, for his kindness in identifying the adults:—

LEPIDIOTA ALBOHIRTA Waterhouse.

The description of the stages has been offered for publication elsewhere (Contribution No. XXX. from this laboratory).

THE EGG.

Length of Stage.

Lot Number.	Number of Eggs.	Deposited, 1914.	Hatched.	Length of Stage—Days.
1	12	January 20 ..	February 1* ..	12
2	47	January 29 ..	February 12 ..	14
3	36	January 29 ..	February 12 ..	14
4	19	January 10 ..	January 26* ..	16
5	18	February 5 ..	February 21 ..	16
6	11	January 25 ..	February 11* ..	17
7	2	February 3 ..	February 15 ..	12
8	4	January 18 ..	February 4* ..	17
			Average	14.75

* Approximate date only.

Duration of the Period of Oviposition.

In confinement eggs have been obtained on the following dates:—December 15, 22, 29; all of January and February; March 1. The

period of oviposition is covered by these dates, since the present beetles were obtained from the forest.

Killed by Desiccation.

Fifty-eight eggs, deposited January 20 and left in dry soil, soon shrivelled. Thirteen eggs were divided into two lots on January 20, six placed in moist soil, seven in dry; by February 2 all were dead in the dry lot, hatching in the normal one. Twenty-seven eggs on January 22 were kept in moist soil, the same number exposed to the atmosphere in shade. The latter were completely shrivelled after forty-eight hours, the first hatched February 1. Both lots taken at random from one large lot. Forty eggs were placed February 7 under a shallow layer of moist soil; they were shrivelled by February 9; the soil was then thoroughly dry.

On February 18, six eggs were placed in diffused sunlight (partly cloudy), and six in the shade. The former were shrivelled after one hour, the latter after several. Suitable controls kept under a pile of moist earth remained normal.

Deposition.

Tryon (1896) states that the eggs are deposited in a mass, a cavity having previously been prepared for them by the mother beetle. Also, that in confinement eggs are deposited singly. In both cases they are placed about six inches beneath the soil. In confinement we have met with both cases. Our only experience with eggs in the field yielded eleven of them in a cluster, and which were ploughed up February 4 in dry clay loam of natural forest; they were in a rude cavity and at a depth of seven inches.

THE LARVA.

Number of Stages.

There are three distinct larval stages, judging from the diameter of the head. Direct evidence of this was obtained by rearing. Thus, ten recently hatched larvæ were placed into sifted soil planted to corn on January 26; they were then, of course, in Stage I. On February 17 only eight remained, still in Stage I. On March 2, one larva in Stage II. was noticed upon the surface of the soil. March 14, only four larvæ remained, all in Stage II. On March 30 no change. April 14, two of the larvæ were in II., two in III.; April 22, all four were in the same stage, namely III. May 19, unchanged; and so on June 5, July 20, and August 3.

In a second case, sixteen young larvæ were placed into a pot of sifted soil which was planted to corn. On March 2, or a month later, twelve larvæ remained, four of which had grown into Stage II. On March 14, there were but eight alive, of which six were in Stage II. On April 27, of the two remaining larvæ both were in Stage III.; one recently dead specimen was in II. On May 19, one larva in III. remained, one found dead in III. July 20, the single larva found recently dead, in III.

For measurement of the head, *see* description of the stages.

Development.

At Gordonvale the stages of the larvæ have been found on the following dates:—

Stage I.	Stage II.	Stage III.
January 26	February 15	March 10, 11, 13, 16, 18, 19, 20, 23, 31
February 4, 19, 23	March 3, 9, 10, 11, 13, 16, 18, 20, 23, 31	April 3, 6, 9, 11, 13, 14, 15, 30
March 2, 17, 20	April 3, 6, 8, 10, 17, 18, 30	May 1, 7, 13, 15, 18, 22, 23, 25, 26, 28, 29, 31
April 10, 16	May 1, 7, 11, 15	June 1, 4, 5, 12, 24, 25, 27, 29, 30
		July 1, 2, 9, 10, 11, 16, 17, 23, 21, 27, 31
		August
		September
		October 21, 24

At Finchhatton, Mackay*, Stage I. was found on October 17, January 28 at Babinda. At Mossman, Stages II. and III. were found on March 20 and 23, 1912. Thus at Gordonvale, Stage I. is found from January to April, II. from February to May, and III. from March to October.

* This represents a distinct species as found later.

Distribution in Upland and Lowland Cane.

Source of Collection.	Number of Grubs.	
	Lowland.	Upland.
38 stools of cane, dark loam	57	..
27 stools of cane, red volcanic	259	..
160 stools of cane, red volcanic	..	1,150
Average per stool—		
Dark loam	1·5	..
Volcanic	9·5	
	Average 4·8	
Volcanic	..	7
24,153 yds. of plough furrows, mixed soil ..	1,045	..
4,620 yds. of plough furrows, mixed soil ..	29	..
17,534 yds. of plough furrows, mixed soils ..	..	721
Average per yard of furrow	·037	·041

Distribution in Regard to Habitat.

This species occurs (and has been found) as a larva in the following situations:—In organic matter in the sand of (dry) river-bed (rarely); in canefields of volcanic, sandy loam, and clay-loam soils (commonly); in natural forest or bush, in various soils up to 1,000 feet; roots of grasses (common); under grass on sidewalks of town (common); and in fields; under the roots of corn and grass; under logs in an orange

orchard; under logs in forest; under stones at roadside; in waste land overgrown with weeds; in canefields in jungle country; and in rubbish and weeds, sandy soil near river.

Distribution in Forest or Bush and Cane.

The following table summarizes:—

Source of Collection.	Number of Grubs.	
	Forest or Native Bush.	Canefields.
92,006 yards of plough furrows, random fields ..	..	1,715
21,700 yards of plough furrows, random fields, first cultivation	76	..
Average per yard of furrow	·0035	·018

Distribution in Regard to Soils.

Of 2,546 larvæ of this species of which record was kept concerning the kind of soil from which obtained, they were distributed as follows:—

Red Volcanic.	Clay Loam.	Sandy Loam.	Sand.
1,874 ..	656 ..	14 ..	2

At first sight, these figures mean that this species is nearly three times more numerous in volcanic soils than in ordinary dark clays but the great preponderance may be due to the fact that more collections were made from the first class of soils or that this class preponderates in the region of the collections. If we assume that they are equally abundant in the two kinds of soil and that, for every time a collection is made from the clays, two are made from the red soils, then it is easily understood how such a kind of statistic is arrived at. It is therefore necessary that the condition in regard to the two be equalised by being made alike in kind before they become comparable. This has been done in the next group of figures, by making the collections equal in quantity and, so far as possible, in quality. The figures now approximate the true distribution as follows:—

Collection No.	Source of Collection.	No. of Grubs.		Averages.	
		Red Volcanic.	Clay Loam.	Per Stool.	Per Yard.
1 ..	38 cane stools ..	..	57	1·5	..
2 ..	12,505 yds. plough furrows	..	587	..	·047
3 ..	146 cane stools ..	1,236	..	8·4	..
4 ..	31,074 yds. plough furrows	899	..	..	0·25

The data are not as yet very full but are being continually gathered. From such data as have been given, the species seems to be equally abundant in the two soils. That the species occurs in sandy loam is evidenced by the fact that in one instance sixty specimens were collected from cane growing on an alluvial flat by following the plough along nineteen furrows of about a length of one hundred yards each. Our collections from this soil are not abundant enough to be comparable.

Feeding Habits of the Larvæ.

The grubs* appear to stand nearly in the same relation to the soil as do earthworms. That is to say, they are continually passing large quantities of soil through their bodies, altering to a certain extent, no doubt, its chemical nature and considerably changing its physical texture. This alteration is brought about by the fact that the organic matter of the ingested soil is partially digested and used as food while the soil is expelled from the anus in the form of a pellet. This constant movement of soil through their bodies, combined with the loosening effect on the soil of locomotory movements of the legs and mandibles, must have in the long run an important effect on the character of soils in a grub-infested area. But, unlike earthworms, grubs do not to any extent transport soil from beneath to the surface.

The following evidence has been collected to show that the grubs subsist largely upon the organic matter in the soil, attacking living vegetation at the same time but not constantly and habitually. Habitually and constantly, they are swallowing soil, extracting partially its organic content, yet a supply of living vegetation seems necessary for their normal development:—

(1) Young larvæ when hatched are wholly white, and remain so until placed into bare soil, after which, in the course of a day or so, they become coloured—the colour due to soil which has been ingested. That they are not starved is shown by their growth and appearance.

(2) Larvæ kept in bare soil pass, for days at a time, large amounts of excrement. This would not be possible unless food was being obtained.

(3) Larvæ kept in bare soil mixed with paris green invariably die after about three days.

(4) Starved grubs have never been found in nature, though coming from bare soil or from some depth beneath the roots of grasses. Larvæ obtained from a piece of land maintained for three months in a state of barrenness were as plump as usual, their food canals full of organic matter mixed with soil.

(5) Grubs are healthy for several months in bare soil without access to living vegetation.

(6) In cultivated canefields, the larvæ are often found in bare parts some distance away from living plants and apparently unable to reach same for several days at least.

(7) Larvæ kept in pure sand or in empty glasses commence to shrivel after several days and to die after a week.

(8) Grubs are not habitually and constantly attendant upon plants.

(9) Examination of the food canal shows considerable variation in the nature of the contents, which always is a mixture of soil and organic matter of vegetable origin, the organic matter sometimes predominating, often the soil doing so.

(10) Forbes (1907) states that Stiles has shown that a certain intestinal parasite of swine passes an intermediate stage

* This refers to all species feeding on living vegetable matter and to most others.

in the intestines of white grubs (North American). These parasites must be ingested with soil containing the excrement of swine probably, or by direct ingestion of the excrement. If the ingestion of the soil by these grubs was purely accidental and of small amount, it is most likely that the parasite would be unable to survive, yet they are abundant. It is most likely, then, that they must be habitual soil-swallowers.

The following experiment shows that vegetable food is necessary for continued development of the larva *albohirta*:—On February 2, sixteen recently hatched larvæ were placed into each of two flower-pots containing sifted volcanic soil, one barren, the other planted to corn. The larvæ had been selected at random. A month later, the pots were dumped and the earth examined, resulting in finding two larvæ in the barren pot and twelve in that containing corn; of the latter four had so grown as to have molted into Stage II., while the other eight were in cells, preparatory to molting. On April 14, in the fed lot, molting into Stage III. had commenced. Of the larvæ in the barren pot, one was accidentally killed while the other was discarded. The experiment was repeated with similar results.

The following experiment was performed with paris green, mixed with the soil in one pot in about the proportion of one to twenty:—On January 29, three larvæ were placed into each of these receptacles, two similar flower-pots, one with sifted volcanic soil, the other with similar soil mixed with paris green and an empty glass. By February 2, examinations showed that the larvæ in the soil (the control) were normal, those in the poisoned soil dead, those in the glass showing evident symptoms of starvation (commencing to shrivel). Experiment repeated with the two pots, and on February 9 the same results were noted. Repeated with same results on February 14. The control larvæ were the same individuals throughout.

Behaviour of the Larva in Confinement.

In rearing this species, use was made of ordinary wooden boxes filled with sifted soil and planted to corn. After the cage was prepared, the larvæ were simply placed upon the surface of its soil and allowed to enter of their own accord. Usually, those not entering were discarded. In many cases, holes were punched into the soil to give them a good start. After once under, they were never seen again (or very rarely). No delay occurred in entering. They thus appear to be out of their element on the soil surface, and light appears unpleasant to them (or else the lack of contact on all sides of their body). The corn in the cages was renewed about every three weeks and the soil was kept moist by sprinkling from above. In bringing specimens in from the field, tin boxes were used full of the native soil. Wooden boxes sunk into the

earth with wire gauze bottoms were used later with more success and also wire gauze cages of various depths. The larvæ are not very sensitive to handling.

Locomotion.

The larvæ have never been observed to come to the surface of the soil and crawl. Locomotion, therefore, is very laborious, and after the usual fashion of the young of this group of beetles. On the surface, however, the larvæ are capable of crawling upon their venters, moving with moderate rapidity.

PUPA.

Depth at which Formed.

At Mackay (Mirani), October 18, 1911, a pupa was found in the dark soil of a canefield at a depth of 15 inches. At Mossman on October 31, 1911, two pupæ were found at an average depth of 1 foot; this in a canefield. At Gordonvale, November 20, 1911, in a canefield of sandy soil near the Mulgrave River, one was found at a depth of 6 inches; the soil was dry for the first 5 inches. In a similar field, the same date, one was found at 5 inches. In a strip of sod between this canefield and the bank of the river, two pupal chambers were found at the depth of 5 inches. In red volcanic soil of canefields at Gordonvale, Mr. J. A. Hadley obtained a pupa at a depth of 3 feet and another at 8 inches. On November 28, a pupal chamber was found 4 inches below the surface in sandy loam, and another 5½ inches.

When confined in cages of 14 inches square, the great majority of the six or more thousand grubs so kept pupated at or toward the bottom where there was sure to be more moisture. When confined in deep wire cages sunk into the earth to depths of 1¾ feet, 16 inches, 37 inches, 42 inches, 33 inches, 53 inches, 55 inches, and 43 inches, the larvæ always pupated in the bottom half-foot or so of soil, though in these cases this part of the soil was certainly no more moist than that some inches above it. In flower-pots sunk into the earth for depths not exceeding one foot, pupation occurred near the bottom. It seems an instinct at this time for the grub to burrow downward indefinitely.

Manner of Formation.

All the pupæ seen by us were in smooth-walled earthen cells and were naked—that is, not enclosed by the larval cast. They lie on their backs.

Duration of the Period of Pupation.

Pupæ have been recorded on the following dates at Gordonvale:—

October 13, 14, 15, 17, 20, 23, 24, 26, 27.
November 6, 8, 11, 17, 25.
December 8.

The period extends, therefore, from about October 13 to December

8. The great majority were met with in October. One pupa was found on August 6, 1913, evidently an exceptional case. Larvæ have been found in pupal chambers as early as July 20, but this is exceptionally early. The first pupa ever found was on August 14 in confinement.

Length of Pupal Stage.

Of thirty-five cases noted in respect to this—but not perfect records, because the time of pupation was never accurately obtained—the time as pupa ranged from eight days to twenty-seven days. The real period must therefore exceed twenty-seven days by several days.

THE ADULT.

Period of Adult Aerial Existence.

Adults have been recorded on the following dates:—

November 4, 12, 21, 23, 24, 25, 27, 28, 30.
December 1, 4, 6, 9, 10, 12, 13, 14, 16, 19, 20, 21, 23, 26.
January 1, 2, 6, 7, 8, 12, 14, 15, 16, 18, 19, 23, 24, 28, 29.
February 5, 6, 7, 10, 13, 14, 18, 20, 21, 23, 26.
March 25.

The maximum frequency is approximated by the relative lengths of the rows of dates.

Period of Emergence from Pupæ.

This means actual transformation into the adult in the pupal chamber below the earth's surface; but as this phenomenon is but rarely observed, the dates given really refer to the times at which newly emerged adults were found in the soil, or at least those which had never left the soil. These are easily recognised by their appearance. They have been found on the following dates:—

October 14, 15, 16, 21, 26, 28, 31.
November 4, 5, 7, 10, 11, 12, 13, 14, 15, 19, 20, 21, 22, 25, 28.
December 3, 11, 15, 18, 19, 22, 24.
January 23.

The depth at which found varied from just under the surface to depths of a foot or more, but the larger number were turned up by the plough. The frequency is approximated by the relative lengths of the lines. A fresh emergence of adults from the soil has been noted as late as January 23*.

Length of Adult Aerial Life.

In order to obtain data on this, it became necessary to capture beetles and confine them indoors with food. The table summarises. The material was from forest:—

* Transformation in confinement was always early, so that it may be assumed for the present that the adults dig their way out at the earliest opportunity, at least after varying intervals of time.

LENGTH OF ADULT AERIAL LIFE IN CONFINEMENT WITH FOOD.

Material from Natural Habitats.

Lot Number.	Number of Beetles.			Date Collected.	Date of Death.		Length of Life—Days.	
	♂	♀	Total.		♂	♀	♂	♀
1	4	12	16	Jan. 12	Jan. 26	Jan. 26	14	14
2	..	2	2	Jan. 18	Jan. 26	Jan. 28	..	10
3	1	1	2	Jan. 11	Jan. 19	Jan. 27	8	16
4	..	1	1	Feb. 17	..	Feb. 28	..	11
5	..	1	1	Feb. 17	..	Feb. 27	..	10
6	1	1	2	Jan. 14	Jan. 28	Jan. 28	14	14
7	2	7	9	Jan. 7	Jan. 15	Jan. 15	8	8
8	2	1	3	Jan. 7	Jan. 26	Jan. 26	19	19
9	4	2	6	Jan. 7	Jan. 12	Jan. 12	5	5
10	..	2	2	Jan. 12	..	Jan. 26	..	14
11	..	2	2	Feb. 23	..	Mar. 4	..	11
12	..	1	1	Feb. 6	..	Feb. 24	..	18
13	..	2	2	Jan. 27	..	Feb. 10	..	14
14	7	5	12	Jan. 27	Feb. 7	Feb. 7	11	11
15	..	1	1	Feb. 7	..	Feb. 14	..	7
16	..	1	1	Feb. 17	..	Feb. 25	..	8
17	1	..	1	Jan. 12	Jan. 20	..	8	..
18	..	1	1	Jan. 12	..	Jan. 23	..	11
19	..	1	1	Jan. 28	..	Feb. 8	..	11
20	..	1	1	Feb. 6	..	Feb. 20	..	14
21	..	2	2	Jan. 12	..	Jan. 23	..	11
22	..	1	1	Jan. 28	..	Feb. 10	..	13
23	..	2	2	Jan. 14	..	Jan. 26	..	12
24	5	11	16	Jan. 15	Jan. 27	Jan. 27	..	12
25	1	..	1	Jan. 11	Jan. 20	..	9	..
26	..	1	1	Jan. 11	..	Jan. 29	..	18
27	1	..	1	Feb. 9	Feb. 15	..	6	..
28	..	1	1	Feb. 9	..	Feb. 20	..	11
29	..	1	1	Jan. 28	..	Feb. 9	..	12
30	..	1	1	Feb. 8	..	Feb. 20	..	12
31	1	..	1	Jan. 12	Jan. 20	..	8	..
32	..	1	1	Jan. 12	..	Jan. 27	..	15
33	..	2	2	Jan. 14	..	Jan. 26	..	12
34	7	6	13	Dec. 24	Jan. 6	Jan. 6	13	13
35	4	4	8	Jan. 6	Jan. 19	Jan. 19	13	13
36	10	10	20	Jan. 8	Jan. 19	Jan. 19	11	11
37	1	1	2	Jan. 8	Jan. 18	Jan. 18	10	10
38	..	..	9	Feb. 7	Feb. 18	Feb. 18	11	11
39	..	..	39	Feb. 10	Feb. 22	Feb. 22	12	12
40	..	..	59	Feb. 11	Feb. 22	Feb. 22	11	11
41	..	..	17	Feb. 14	Feb. 24	Feb. 24	10	10
42	..	..	18	Feb. 20	Mar. 4	Mar. 4	12	12
Totals ..	52	89	283	..	..	..	213	455
Averages	..	..	..	..	..	..	10·14	12

The actual period of aerial existence is only approximated here. If beetles are confined before they have left the soil (and thus before they have taken food), they will live a considerable period of time, as shown

in the following summary. Very little or no food is taken, and they seem to be awaiting the action of some stimulus:—

LENGTH OF ADULT LIFE IN CONFINEMENT WITH FOOD.

The Material from the Soil or from Rearing Cages.

Lot Number.	Number of Beetles.			Date.	Death.		Length—Days.	
	♂	♀	Total.		♂	♀	♂	♀
1	1	1	2	Nov. 7	Dec. 8	Dec. 26	31	49
2	1	1	2	Nov. 5	Dec. 23	Dec. 27	48	52
3	1	1	2	Dec. 18	Jan 6	Feb. 9	19	53
4	1	1	2	Nov. 7	Dec. 14	Dec. 25	37	48
5	1	1	2	Nov. 7	Dec. 28	Dec. 29	51	52
6	1	1	2	Nov. 7	Dec. 28	Dec. 28	51	51
7	7	..	7	Dec. 20	Jan. 2	..	13	..
8	2	6	8	Dec. 20	Jan. 12	Jan. 12	23	23
9	4	..	4	Dec. 20	Jan. 26	..	37	..
10	..	1	1	Dec. 20	..	Feb. 4	..	46
11	4	..	4	Nov. 10	Jan. 3	..	54	..
12	..	1	1	Nov. 10	..	Jan. 10	..	61
13	10	2	12	Nov. 10	Dec. 9	Dec. 9	29	29
14	3	4	7	Nov. 10	Dec. 16	Dec. 16	36	36
15	3	1	4	Nov. 10	Dec. 23	Dec. 23	43	43
16	..	3	3	Nov. 10	..	Dec. 30	..	50
17	..	2	2	Nov. 10	..	Jan. 6	..	57
18	1	..	1	Nov. 11	Dec. 8	..	27	..
19	1	..	1	Nov. 11	Dec. 22	..	41	..
20	..	1	1	Nov. 11	..	Dec. 29	..	48
21	..	1	1	Nov. 11	..	Jan. 6	..	56
22	1	..	1	Nov. 11	Dec. 12	..	31	..
23	..	2	2	Nov. 11	..	Jan. 3	..	53
24	1	..	1	Nov. 12	Dec. 22	..	40	..
25	..	1	1	Nov. 12	..	Jan. 6	..	55
26	3	4	7	Nov. 13	Jan. 3	Jan. 3	51	51
27	1	1	2	Nov. 13	Jan. 5	Jan. 5	53	53
28	1	..	1	Dec. 11	Dec. 22	..	11	..
29	..	1	1	Dec. 11	..	Jan. 6	..	26

LENGTH OF LIFE IN CONFINEMENT WITHOUT FOOD.

Lot Number.	Number of Beetles.			Date.	Death.		Length of Life—Days.	
	♂	♀	Total.		♂	♀	♂	♀
Material from Forest. (Emerged Adult.)								
1	1	1	2	Jan. 7	Jan. 23	Jan. 23	16	16
2	1	1	2	Jan. 19	Jan. 23	Jan. 23	4	4
3	..	2	2	Feb. 5	..	Feb. 13	..	8
4	..	1	1	Jan. 28	..	Feb. 7	..	10
5	..	1	1	Feb. 18	..	Feb. 27	..	9
6	1	1	2	Feb. 18	Mar. 1	Mar. 1	10	11
7	..	1	1	Jan. 19	..	Jan. 27	..	8
8	..	2	2	Feb. 5	..	Feb. 17	..	12
9	..	2	2	Feb. 17	..	Feb. 28	..	11
10	1	..	1	Jan. 7	Jan. 17	..	10	..
11	..	2	2	Feb. 5	..	Feb. 14	..	9
12	..	1	1	Nov. 25	..	Nov. 30	..	5
13	1	..	1	Dec. 1	Dec. 5	..	4	..
14	1	..	1	Nov. 30	Dec. 4	..	4	..
15	..	1	1	Jan. 7	..	Jan. 19	..	12
16	..	1	1	Jan. 10	..	Jan. 18	..	8
17	..	1	1	Feb. 23	..	Mar. 5	..	12
18	..	2	2	Feb. 5	..	Feb. 14	..	9
19	..	1	1	Jan. 28	..	Feb. 6	..	9
20	1	1	2	Jan. 16	Jan. 26	Jan. 29	10	13
21	1	1	2	Jan. 16	Jan. 27	Jan. 29	11	13
22	1	1	2	Feb. 5	Feb. 11	Feb. 15	6	10
23	1	1	2	Jan. 19	Jan. 26	Feb. 8	7	20
The Material. (Unemerged Adults.)								
1	..	1	1	Nov. 22	..	Jan. 18	..	26
2	1	1	2	Dec. 3	Mar. 10	Mar. 6	97	93
3	2	..	2	Dec. 15	Jan. 21	..	37	..
4	..	1	1	Dec. 3	..	Jan. 19	..	47
5	1	..	1	Dec. 19	Dec. 29	..	10	..
6	1	1	2	Dec. 24	Jan. 7	Jan. 7	14	14
7	..	1	1	Dec. 24	..	Jan. 3	..	10
8	1	2	3	Dec. 24	Jan. 8	Jan. 8	15	15
9	1	..	1	Nov. 5	Jan. 10	..	66	..
10	1	..	1	Nov. 22	Dec. 12	..	20	..
11	1	..	1	Nov. 21	Dec. 18	..	27	..
12	..	1	1	Nov. 15	..	Dec. 27	..	42
13	1	1	2	Oct. 21	Nov. 14	Dec. 26	24	66
14	2	..	2	Nov. 13	Dec. 24	..	11	..
15	1	..	1	Nov. 18	Nov. 25	..	5	..
16	..	2	2	Oct. 26	..	Jan. 2	..	68
17	1	..	1	Jan. 23	Jan. 27	..	4	..
18	2	..	2	Oct. 15	Dec. 14	..	50	..
19	1	1	2	Dec. 22	Jan. 5	Jan. 5	14	14
20	2	..	2	Dec. 22	Jan. 6	..	15	..
21	1	1	2	Dec. 22	Jan. 3	Jan. 7	12	16
22	2	2	4	Dec. 18	Jan. 8	Jan. 8	21	21
23	1	1	2	Dec. 18	Jan. 14	Jan. 11	27	24
24	1	..	1	Oct. 26	Dec. 25	..	60	..
25	1	..	1	Nov. 14	Nov. 20	..	6	..
26	2	1	3	Dec. 18	Jan. 4	Jan. 4	17	17
27	1	1	2	Nov. 12	Jan. 4	Jan. 14	23	33

Proportion of the Sexes.

The following table summarises the relative number of the sexes at different times during the beetle season:—

Lot No.	Source.	Date.	Males.	Females.	Total.	Proportion.
1	Unemerged, cages ..	October ..	11	8	19	
2	Unemerged, field ..	October ..	5	4	9	
3	Emerged	October ..	2	..	2	
4	Unemerged, cages ..	November	58	71	129	
5	Unemerged, field ..	November	12	3	15	
6	Emerged	November	45	22	67	
7	Unemerged, cages ..	December..	53	20	73	
8	Unemerged, field ..	December..	7	6	13	
9	Emerged	December..	797	731	1,528	
10	Unemerged, cages ..	January ..	..	..	..	
11	Unemerged, field ..	January ..	3	3	6	
12	Emerged	January ..	558	909	1,467	
13	Emerged	February ..	12	59	71	
14	Miscellaneous ..	..	32	23	55	
			1,595	1,859	3,454	145 : 169

Flight of Adults.

The adults of this species are capable of flying considerable distances; we have followed them in flight as far as the eye would allow.

Mating.

The manner of mating is normal for Coleoptera. The act follows upon a period of feeding.

Development of Eggs in the Ovaries.

Upon emergence from the soil, the ovaries of the female are practically empty, development advancing as food is taken. Mating may occur before the eggs in the ovaries have reached perfection. Nearly ten days or even more elapse between emergence and perfect development of the ovaries.

Number of Eggs Laid.

The largest number of eggs found by dissection was 24, on November 27. This seemed to be the full amount, the eggs equal in size and perfect. Other dissections, unfortunately, were made too early, resulting in finding the ovaries empty.

The largest number of eggs deposited by a female (captured from forest February 17, and confined with food) was 24; these were in a rude cell with the dead body of the mother insect. Adults taken from cages or from the soil before natural emergence would never deposit eggs, for the reason that the eggs were never developed in the ovaries. As these latter would never feed either, it would seem certain that the eggs do not develop until food is taken. Adults which have fed (captured from forested areas), when brought into the laboratory and starved, deposit eggs.

The Relative Abundance of the Species.

This is best shown by counting the larvæ of random collections. The following summary then includes every soil-inhabiting grub collected and identified by us:—

THE RELATIVE NUMBERS OF LEPIDIOTA ALBOHIRTA IN RANDOM COLLECTIONS OF GRUBS.

Species—	533.	*Albo-hirta*	*Anoplog-nathus.*	Miscel-laneous.	*Caca-chroa.*	377	646.	678.	*Xylo-trupes.*
Total	619	4,313	1,871	60	556	246	3	16	322

Species— *Dasygnathus.*	349.	89.	364.	655 and 434.	576.	45.	607.	609.	587 and 650.
Total 215	15	76	12	680	270	2	20	8 21 — 29	182

The grand total is 9,577. It would seem, then, that, of all the soil-infesting scarabæid grubs at all commonly met with in the various natural and artificial habitats in the vicinity of Gordonvale, *albohirta* is commonest. Nearly every other specimen met with is this species, as the figures show.

THE RELATIVE ABUNDANCE OF THE SPECIES IN THE CANEFIELDS.

The following table shows this in random collections of larvæ from fields of cane:—

THE RELATIVE ABUNDANCE OF LEPIDIOTA ALBOHIRTA IN RANDOM COLLECTIONS FROM CANEFIELDS.

Species— *Anplognathus.*	89.	*Albohirta.*	45.	576.	533.	607.	*Dasygnathus.*
1,369	58	3,804	1	1	332	1	111

Species— 609.	349.	377.	Miscel-laneous.	*Cacachroa.*	*Xylotrupes.*	434.	653.	650.
5	2	158	177	105	1	1	2	44

The grand total is 6,172. Thus in canefields every other scarabæid larva met with is this species.

THE RELATIVE ABUNDANCE OF THE SPECIES UNDER STOOLS OF CANE.

Without actually watching with greatest care, the evidence of injury to cane is best obtained by collecting species from beneath cane-stools, especially in fields where the crop is showing obvious injury, or the roots have been eaten. Evidence by observation is very difficult to obtain, owing to the hidden life of the larvæ. The following table summarises,

therefore, random collections found immediately under individual cane plants. The data are not very numerous:—

Species— *Albohirta.*	547.	377.	650.	533.	646.	*Cacachroa.*	*Anoplognathus.*	434.	*Dasygnathus.*
1,377	3	49	5	51	2	38	8	1	5

The total is 1,539. These data show very plainly that this species is overwhelmingly the most abundant under the roots of cane-plants, and consequently the one to which most of the damage must be attributed. Taking the three species of *Lepidiota* out, there would remain a very negligible quantity to do damage. Thus, *Lepidiota* must be considered primarily cane beetles, and this species (*albohirta*) *the* cane beetle, at least so far in the locality in which the studies were made.

The Relative Abundance of the Species in Natural Forest.

From Random Collections. The data as yet not large. A larger amount of it was unusable on account of the identification factor being absent.

Species— *Albohirta.*	533.	377 and 609.	650.	364.	89.	646.	587.
123	172	116	86	2	19	5	29

Species— *Xylotrupes.*	539.	434.	*Anoplognathus.*	607.	*Dasygnathus.*	*Cacachroa.*
4	1	3	74	17	44	312

Percentages :—

The total is 1,027. From these data, the *cacachroa* seems must abundant in nature as far as this habitat is concerned. The species *albohirta* here falls from an easy first place (in canefields) to an uneasy third.

Behaviour of Adults in Confinement.

When healthy adults are placed into suitable breeding cages and supplied with food, they follow in general their normal life routine, becoming active at night, inactive in the daytime. But during the latter period, instead of remaining above ground, they invariably hide themselves in the soil. Their behaviour, then, is similar to that of the various species of the North American genus *Lachnosterna*. Adults which of themselves have never left the soil, but which were taken from cages or ploughed up in the field, at once bury themselves and never leave the soil, even if placed in the presence of food. They seem physiologically different from those which have naturally left the soil because of some instinct, or in response to some stimulus.

The Habits and Food of Adults.

The beetles of this species commence to emerge from the ground

about half an hour before sundown, or just before dusk, and the flight continues for about half an hour. A tree or shrub is chosen, usually close to a canefield, on which the beetles alight and immediately commence feeding. Observations show that through the night the beetles are quiescent and do not fly, but towards morning and just before daybreak some leave their all-night position and fly off. Again at twilight, when a position has been taken up on the verge of a canefield, it has been noticed that there are two flights of beetles, one from the cane into the forest, the other and smaller flight from the forest into the cane. Those flying into the fields would probably be females about to deposit eggs, which would also be apparent of those flying at dawn. During the day the beetles remain clinging to the feeding-tree and do not fly until evening. In captivity, numbers hid in the earth during the day, coming to the surface again at dusk; but this does not appear to occur in the natural state, and it has been found that where beetles were in evidence before daylight the numbers were not diminished during the day. No food is eaten during the day, the beetles remaining hanging to the hidden and protected sides of the leaves, and sometimes to the smaller stems. Rain does not appear to affect this habit, as in rainy, windy weather they have been noticed in their usual positions. Mating has not been observed during the day, and but few observations have been made, but a mating pair has been captured at 7.30 p.m. (*i.e.*, shortly after dark). As with allied species (namely, *frenchi* and *rothei*), this probably takes place immediately after emergence.

A sharp jar suffices to shake the beetles from the feeding-tree, but windy weather necessitates sharper jarring as they then cling more tightly. They fall headlong to the ground, and after a few moments bury themselves beneath any débris that lies near, not attempting to fly except in the afternoon, when they frequently spread their wings and sail or fly some distance before alighting. Individuals captured and thrown into the air generally fly. How far the beetles fly is a question not determined accurately.

Trees on the edge of canefields are usually chosen for feeding purposes but all through the forest and often a mile or two from canefields beetles can be found. Dead specimens have been picked up all the way up the forested slopes of Mount Pyramid, 3,000 feet, near Gordonvale, except on the extreme summit, and fully a mile, as the crow flies, from the nearest canefield.

The flight is slow and laborious, with a low drumming sound, the elytra being well raised. It would seem that they cannot see distinctly, as during flight numbers hit against roofs and walls of houses, &c. Artificial lights do not attract them, though occasionally stray specimens will fly to a light, but, considering the enormous numbers that must fly within the range of lights, this is only to be expected.

Sometimes hundreds of beetles will congregate on one tree to feed, especially if the tree be large, but as a general rule only a small number collect on one tree. Special situations are often chosen, and numbers may be gathered day after day in one small area, where none can be found elsewhere in the neighbourhood. Trees of any size may be selected, but small shrubs and saplings (from 8 to 25 feet high) appear to be preferred; however, a large tree will often attract scores of beetles, while rarely is a small one crowded. That certain food-plants are favoured is

evident; observations, however, have been restricted to seasons when the beetles were comparatively few, and in abundant seasons trees may be attacked indiscriminately. Food-plants may belong to almost any order, whereas trees in the same genus, and obviously very closely related, may or may not suffer defoliation. Jungle (*i.e.*, scrub) or forest trees are attacked without difference. Around Gordonvale the country is mostly forest, which may account for the preponderance of forest trees given in the food list. Tryon (in 1896, p. 19) remarks as follows:—"Since their (*i.e.*, the beetles') food is yielded almost wholly by the leaves of so-called scrub trees, they are almost exclusively found within or in the vicinity of scrubs, or along the course of creeks that are fringed by scrub vegetation." Our experience at Gordonvale shows that the beetles feed throughout the forest land as well as on the fringes of jungle vegetation. This may be accounted for by the prevalence of forest (*i.e.*, open bush with typical Australian *Eucalyptus* and other flora) lands. Individual beetles may feed on more than one kind of food-plant, as has been abundantly proved in captivity. The following list of food-plants has been compiled from direct observation. As most of the observations have been made during the past year, when beetles were not plentiful, and almost solely in the vicinity of Gordonvale, the list is no doubt far from complete, though it probably includes most of the commoner and more frequent food-plants.

(1) The Figs (*Ficus* sp.).—Five species of *Ficus* are known to us that are attacked by the beetles; they are amongst the commonest food-plants. Of these five, the most favoured is the ornamental cultivated weeping fig. Each plant of this species is periodically visited by the beetles, although no instance has come to our knowledge of any of these trees being greatly defoliated. The four other species are usually met with along edges of jungles, and are not so preferred.

(2) *Eugenia* sp. (Wild or River Cherry).—A very common plant along the Mulgrave River and lowland creek banks. Only one record of this tree being a food-plant was made, when about twenty beetles were gathered from one tree.

(3) *Philanthus* sp.—A rather common tree growing in the vicinity of jungles, but beetles have been observed upon it only once.

(4) Miscellaneous Jungle Trees.—On several occasions, beetles have been taken from unknown jungle trees.

(5) Leichhardt Tree.—Very plentiful in swampy streams, or along creek banks, but rarely attacked.

(6) The Cultivated Mango.—Odd specimens have been taken several times from the leaves of this tree, but it is not an important food-plant.

(7) The Cocoanut Palm.—A rare tree around Gordonvale. Trees have been noticed that were greatly damaged.

(8) Tar Tree.—A native tree attaining great size and growing freely along the fringes of jungles. Beetles have been found attacking it on several occasions, trees of large size, from 50 to 70 feet high, being attacked.

(9) *Careya australis.*—A common tree of the forest lowlands. A few trees were observed loaded with beetles, in December, 1911, but these are the only records.

(10) Common Cultivated Bananas.—Banana plantations are frequently visited by the beetles, numbers of the plants being badly eaten, leaving only the midrib.

(11) Wattles (*Acacia* sp.).—The wattle, known locally as the black wattle, is a rather favourite food-plant. It rarely reaches a height of 30 feet, but the small saplings are usually attacked. Another species of wattle, growing with this one in the forest areas, has not yet been observed eaten.

(12) *Melaleucas.*—Three species of the genus *Melaleuca* grow commonly in the forest around Gordonvale, two of which bear white flowers, the third beautiful pink blossoms. One of the white-flowered species is especially common, growing in the low-lying areas where water often lies for several months in the year; this tree is preferred to a very great extent, being usually favoured when attaining a height of from 15 to 30 feet, and the same clump of trees has been found to yield beetles each day for a month. The two other species are not used as food-plants to nearly such an extent.

(13) The Ironbark (*Eucalyptus siderophloia* (?), or *crebra* (?)).—This tree is met with on the higher forest lands, and is thus seldom situated near canefields. Odd trees growing alongside canefields were several times noticed infested with beetles.

(14) The Bloodwood (*Eucalyptus corymbosa* (?)).—A very common tree right throughout the forest, except in the very swampy lands, and rarely attaining a great height. Small trees are frequently attacked by the beetles.

(15) Moreton Bay Ash (*Eucalyptus tesselaris*).—Scattered throughout the forest, but not common. By far the favourite food-plant of *albohirta,* trees of all sizes being defoliated indiscriminately, and in the beetle season one rarely finds one of these trees within a mile or more of a canefield that is not infested, while the surrounding trees are totally devoid of beetles.

The observations noted above serve to show that *Lepidiota albohirta* is partial to the foliage of certain trees, while numbers are never attacked. Thus, among the common trees growing in the vicinity of canefields around Gordonvale, *Eucalyptus tesselaris, E. corymbosa, Melaleuca* sp., Black Wattle, Banana, and the species of *Ficus* are most often attacked; while such common trees as *Careya australis, Tristania suaveolens, Eucalyptus platyphylla,* the Mango, and the second species of Wattle are rarely if ever chosen as food.

LEPIDIOTA FRENCHI Macl. **No. 533.**

THE EGG.

None obtained.

THE LARVA.

At Gordonvale, the stages of the larva have been found on the following dates:—

Stage I.	Stage II.	Stage III.
March 21	January 28	January 20, 23
April 7, 8, 23	February 5	February 5, 15, 24
June 12	March 9, 28	March 3, 9, 10, 11, 19
	April 1, 2, 3, 20, 23, 24, 29, 30	April 2, 3, 16, 20, 30
	May 2, 11, 13, 25, 26	May 2, 13, 20, 23, 25, 27, 31
	June 7, 8, 12, 15, 28	June 4, 7, 8, 12, 25, 26
	July 5, 7, 11, 22, 30	July 7, 8, 16, 22
	August 8, 13, 17, 21, 26	August 8, 14, 19
	September	September 3
	October 28, 23	October 28, 23
	November 16, 18	November 3, 13, 16, 18, 25
	December 15, 24	December 4, 20, 22, 24

At Babinda, Stages II. and III. have been found January 27; at Mossman, III. on October 31, March 21; Cooktown, I. February 2, 28; II. February 8, March 1; III. February 28.

Thus Stage I. is found from end of January to June (probably an odd specimen April, therefore being limit of stage), Stages II. and III. throughout the year. There is abundant proof that this species, unlike *albohirta*, has a life-cycle of more than one year, as Stages II. and III. can be found throughout the year. Thus 25 Stage II. were taken from canefields May 14, 1913, and kept in captivity; on October 23, 22 were alive, still in Stage II.; by November 18, two had entered into Stage III.; by December 17, more were in Stage III., but majority still in II.; on January 28, 1914, majority in Stage III., a few in II.; not again examined till July 22, when two III. were found.

Distribution in regard to Soils.

Owing to the comparative paucity of this species, there is less data to show its abundance in different soils. The following table summarises some of the data:—

Collection Number.	Source of Collection.	Number of Grubs.		Average per Yard.
		Red Volcanic.	Loam.	
	Plough Furrows—Yds.			
1 ..	1,800	8	..	·004
2 ..	900	3	..	·003
3 ..	1,280	..	9	·00703
4 ..	2,000	4	..	·002
5 ..	440	..	24	·054
6 ..	1,500	..	3	·002
7 ..	900	..	8	·008
8 ..	1,680	..	7	·00417

Distribution as regards Habitat.

This species appears to occur throughout N.E. Queensland from Cooktown to Cairns. It is found in both forest and jungle soils, in

canefields or under native and other grasses, and is seemingly more abundant there than in canefields. Of a total number of 390 larvæ of which record was kept concerning the habitat, they are distributed as follows:—

Canefields.		Forest Grasses, Weeds, &c.
257	..	133

But of those collected in canefields, 114 were taken in one collection. Moreover, much more collecting has been made in the canefields than in the open.

Distribution in Upland and Lowland.

Of the total number of larvæ in general collections from Upland and Lowland, they are distributed as follows:—

Lowland.		Upland.
81	..	22

Owing, however, to the small number of larvæ, this result is probably not true.

THE PUPA.

We have very little data as to the pupation of this species. Numerous larvæ were found in earthen cells in grass lands at depths varying from 2 to 3½ feet, but usually nearer the lesser depth, in the second week of June. A pupa taken from a bred cage on November 20 emerged December 10; another from a bred cage on November 25 emerged December 12.

EMERGENCE OF ADULTS.

The only dates on which this species has been recorded are—January 22nd, 1912, December 3rd, 10th, 12th, 1912 (bred), February 3rd, 1913, March 13th, 1913, December 20th, 23rd, 1913.

From several grass-plots in the township of Gordonvale, thousands have emerged in the three seasons noted. Emergence takes place soon after dusk, and continues for about half an hour, the emerged beetles circling round low over the surface of the ground, and mating immediately. A walk round one of these plots just after dusk has produced numerous mating pairs, clinging to wire or wooden fences or sides of houses, &c. No food-plants are recorded, but one specimen has been taken from many, on the foliage of bloodwood (*Eucalyptus corymbosa* ?), and several of the forest trees probably constitute the number.

LEPIDIOTA Sp. No. 666.

LARVA.

Known only from the Bundaberg and Childers districts, South Queensland, the specimens having been obtained solely from canefields. The Childers specimens, several Stage III., two Stage II., were taken by following plough, red volcanic soil, upland, July 1. Those from Bundaberg, three Stage III., were taken from under stool of cane, March 9.

LEPIDIOTA Sp. No. 45.

We have only one record of this species, several larvæ stage III. being obtained from a canefield cleared from jungle only six months,

and in which the high stumps of the jungle trees were still standing, Innisfail, North Queensland, January 12, 1912. These may be the larvæ of *Lepidiota froggatti*.

LEPIDIOTA FROGGATTI Macleay.

One adult found lying on a road near jungle, not in a cane area, Yungaburra, 2,500 feet, Cairns district, December 30th, 1911.

LEPIDIOTA Sp. **No. 215.**

Larvæ have been obtained as follows at Gordonvale:—Stage III. from old canefield, red volcanic soil, following plough, 16th June, 1912; Stage III. in captivity, 25th November, 1912; Stage III. from forest, following plough, red volcanic soil, 21st April, 1914; Stage II. from forest, following plough, red volcanic soil, 31st August, 1914. These are our only records, and the species is therefore very rare.

LEPIDIOTA Sp. **No. 377.**

(*Probably L. rothei.*)

THE EGG.

None obtained.

THE LARVA.

At Gordonvale, the stages of the larva have been found on the following dates:—

Stage I.	Stage II.	Stage III.
Nil	March 31 April 21, 30 May 7, 27 June 4, 7, 8 July 7	March 19, 29 April 1, 7, 21 May 1, 12 June 4, 7, 25 July 3, 16, 31 August 12, 20, 26, 31 September 3 October November 16

Thus stage II. is found to middle of July, stage III. from middle of March to middle of November. From the recorded data it would seem that this species does not extend its life-cycle beyond a year.

Distribution in regard to Soils.

Of 121 larvæ of which record was kept concerning the soil, they are distributed as follows:—

Red Volcanic.	Clay or Dark Loam.	Sandy Loam.	Sand.
63 ..	58 ..	— ..	—

That is, the species is no more abundant in volcanic than in loamy soil but since more collecting may have been done in one soil than in another the evidence is far from conclusive.

The following table gives a slight idea of relative abundance:—

Collection Number.	Source of Collection.	Number of Grubs.		Average per Yard.
		Red Volcanic.	Loam.	
	Plough Furrows—Yds.			
1	4,375	..	11	·00251
2	5,760	7	..	·00122
3	3,645	..	13	·00357
4	1,050	8	..	·00762

Distibution as regards Natural Habitat.

Known to us only from the neighbourhood of Gordonvale, and frequenting the open forest lands and grassfields, more than the canefields. Of a total number of 136 larvæ whose habitat was recorded, 104 came from forest and grass land, and 32 from canefields. Of course, these numbers cannot be given too much consideration, still they seem to be about the right proportions. Upland and lowland soils are both infested, but our data are not sufficient to give the relative ratios.

THE PUPA.

None obtained.

EMERGENCE (*i.e.*, Adults of *L. rothei*).

The only dates on which this species has been recorded are—January 22nd, 1912; December 27th, 1912; and February 13th, 1913; December 26th, 1913.

It breeds in the township of Gordonvale in company with *frenchi*, and the remarks regarding the emergence of that species will refer to this also. Specimens have been taken from the foliage of *Eucalyptus platyphylla* and *E. corymbosa*. At dusk on the 24th December, 1912, numbers of this species were observed flying round a clump of young trees of the former food-plant growing in the forest. The flight lasted for about ten minutes and then suddenly ceased. The shrubs were then searched, beetles being found on each tree, all singly, none being noticed mating; they were clinging to the edges of the leaves, forcing the beaks deep into them. Thirteen specimens (ten males, three females) were brought indoors, and enclosed in a wire cage; on last looking at them at 10 p.m. they were still feeding. By next morning they were hiding under dead leaves on the bottom of the cage, where they remained during the day, coming out to feed again at twilight. None mated, though they were kept for three days.

LEPIDIOTA Sp. No. 89.

THE EGG.

None obtained.

THE LARVA.

Only stage III. has been found, taken at Gordonvale on the following dates:—February 15, March 31, April 16, June 23, July 11, 20, August 12, 19. Also taken at Mossman March 22, October 31, November 21; and at Cooktown, February 28 and March 9.

Distribution in regard to Soils.

There is little doubt that this species favours the red volcanic soils, almost all our specimens having been taken in that kind of soil, only

odd individuals coming from black or clay loam or sand. Of a total of 63 larvæ from various collections, 54 came from red volcanic soil, 7 from black or clay loam, and 2 from sand. The species has but once been taken commonly, thirty odd larvæ being captured in a volcanic field, Green Hills, Gordonvale, April 16, 1912.

Distribution in regard to Habitat.

A rather rare species, from Gordonvale, Mossman, and Cooktown, North Queensland. At Cooktown, in February and March, 1914, the larvæ were rather abundant just beneath the surface, around the roots of a native grass in jungle, gravelly soil, while one or two were obtained in rich black loam soil beneath native grasses in forest. At Mossman, a single specimen was found under a log in the jungle, and another beneath a log in a meadow. Around Gordonvale the species is usually met with in canefields, rarely in forest. Thus, of the Gordonvale total, 42 are from canefields, 6 from a cornfield, and only 5 from the open forest. Moreover, the volcanic soils, where the species was most common, have once been jungle lands. From this data it would appear that No. 89 is a natural inhabitant of the jungle. Upland and lowland soils are infested. Our limited data show that around Gordonvale the former is most frequently infested, but as most of the volcanic canefields are upland this would thus be accounted for.

THE PUPA.

None obtained, but a number of larvæ kept in captivity were in earthen cells by August 20, the cells small, but otherwise like those of *albohirta*.

EMERGENCE AND HABITS OF ADULTS.

Adult unknown.

LEPIDIOTA DARWINI, Blackburn.

THE ADULT.

One adult taken from the soil in a canefield, 28th November, 1911, and thousands swarming in *Eucalyptus* on edge of forest, 8 p.m., 23rd November, 1912, both at Gordonvale, are our sole records of this species.

ISODON PUNCTICOLLIS Macleay.

The following records:—One adult caught at light, February 5th, 1913; one adult in soil under grass, March 11th, 1913; one adult reared from pupa taken on March 12th, from black loam, under grass, March 18th, 1913; one adult taken from sandy loam, decayed cane, August 21st, 1913; and one adult taken from volcanic soil, canefield, September 22nd, 1913. All these records from Gordonvale. An adult reared on March 18th lived in confinement, without food, till April 10th.

HAPLONYCHA Sp. (near *bella*).

On June 7th, 1912, larvæ were taken from forest land, and placed in cages indoors; the larvæ were *Dasygnathus*, No. 377, No. 533, and No. 587. When opened on November 20th, the cage contained a pupa of No. 533, two larvæ of No. 377, and two adults of the above species. On June 25th, 1912, larvæ were taken from volcanic soil, canefield, and placed in cages indoors; the larvæ were No. 533, No. 377, and No. 587.

From one of the small larvæ, an adult of the above species was reared November 11th. These results seem to show that this species is the adult of No. 587.

On January 1st, 1913, adults were found at 9 a.m. feeding on the young leaves of *Eucalyptus corymbosa* (?) at Gordonvale.

HAPLONYCHA Sp.

Two adults dug up in clay soil, jungle, Babinda, N.Q., February 11th, 1914.

DASYGNATHUS AUSTRALIS DEJEANI Macleay.

THE EGG.

None obtained.

THE LARVA.

Length of the Stages.

At Gordonvale, the three stages have been obtained on the following dates:—

Stage I.	Stage II.	Stage III.
March 11	April 12, 29	March 28
	May 18, 20	April 9, 20, 22, 30
	June 9	May 2, 3, 8, 13, 15, 17, 26, 31
	July 17, 30	June 2, 7, 18
	August 7, 24	July 6, 16, 30
	September 9	August 10

Also, Stage III. has been taken at Babinda, N.Q., February 11; doubtful specimens of Stage I. at Goondi (Innisfail), N.Q., July 24; Stage III. at Childers, S.Q., July 1, and also at Murwillumbah, Tweed River, N.S.W., May 20, 30. From this data we must conclude that this is another of the species whose life-cycle continues over one year.

Distribution in regard to Soils.

Our data show a proportionately large percentage of larvæ from black or clay loams as compared with red volcanic soils, but owing to their scantiness they cannot be allotted much importance. From all collections where the quality of the soil was recorded, the larvæ are divided as follows: —

Red Volcanic.		Clay or Dark Loam.
23	..	84

Also 57,400 yards of plough furrows, red volcanic, yielded 9 larvæ; 38,550 yards plough furrows, clay or black loam, 52 larvæ.

In individual collections, numbers of larvæ were obtained only from the black or clay loam, as the following table serves to show:—

Collection Number.	Source of Collection.	Number of Grubs.		Average Per Yard.
		Red Volcanic	Clay or Dark Loam.	
1 ..	1,500	..	12 (clay)	·008
2 ..	900	..	8 (clay)	·008
3 ..	1,680	..	16 (black)	·00952
4 ..	660	2	..	·0030

Distribution as regards Habitat.

Distributed throughout the cane and forest lands in the vicinity of Gordonvale, this species is not common. It has been found under canestools, in ploughed canefields, in ploughed corn and grass fields, beneath grasses, native and otherwise, and beneath logs, pieces of board, &c., in forest and cultivated lands. It has also been found from virgin jungle, Babinda, Cairns district, from ploughed canefields, red volcanic soil, Childers, S.Q., from ploughed paspalum and cane fields, Murwillumbah, N.S.W., black-loam soil.

Of the total number collected around Gordonvale, 36 are from forest, grasses, &c., and 81 from cane.

Also, 33,000 yards plough furrows, forest, grasses, &c., yielded 2 larvæ; 61,670 yards plough furrows, canefields, 57 larvæ. Both sets of data thus show a majority in canefields, but here again the records are scanty and not of great value.

Distribution in Upland and Lowland Soils.

As is to be expected, since the rich black loams around Gordonvale are mostly lowlands, and the red volcanic soils are mostly upland, and since the larvæ of this show, according to our data, a decided preference for the loamy soils, upland soils yielded very few larvæ. Of our total number, only 5 are from upland soils, 71 coming from lowland.

THE PUPA.

None obtained.

THE ADULT.

Emergence.

Adults have been obtained in our cages on the following dates:—October 4, 23, 27; November 12; December 1, 10, and 15. It has also been obtained on the following dates:—From soil near cane-roots, Finch-Hatton (Mackay), N.Q., October 17; from soil in canefield, Gordonvale, November 29; from soil beneath log in forest, Gordonvale, December 4; from soil eight inches under surface, roadway, Gordonvale, October 15. Nothing is known as to the habits of the species.

Length of Life of Bred Adults.

A pair of adults found in one of our cages on October 31 was kept for length of life; the male died on December 1, the female on December 12, both unfed.

No. 678.

The larvæ of this species has been found very plentifully in decaying heaps of cane, light sandy loam, around Gordonvale, from end of March to end of August, all being in Stage III. One larva was found pupating on August 24. The adult has not been reared, but is probably one of the smaller brown or black scarabæids.

CACACHROA DECORTICATA Macleay.

THE EGG.

Length of Stage.

Lot Number.	Number of Eggs.	Date Deposited.	Hatched.	Length of Stage —Days.
1	3	Febuary 7-14 ..	By February 24 ..	10-17
2	16	December 22-29 ..	By January 6 ..	8-15
3	12	December 29-2 Jan.	By January 14-18 ..	12-20
4	5	January 2-6 ..	By January 16-19 ..	10-17
5	37	December 22-29 ..	By January 7-10 ..	9-19
6	5	December 29-2 Jan.	By January 14 ..	12-16
			Average	13·75

Duration of Period of Oviposition.

Eggs have been obtained from beetles reared in confinement on all dates from December 22 to January 6. The only eggs laid by beetles taken in the forest and kept in confinement were obtained between February 7-14, 1913.

Deposition.

The eggs are deposited singly or in clusters of less than six, these in confinement. No eggs have been obtained in their natural situation.

Percentage of Larvæ Reared.

When obtained in confinement, the eggs were placed in fine, sifted, damp earth, in glass vessels, at a depth of an inch or two. The following table shows the percentage of mortality:—

Lot. Number.	Number of Eggs Placed in Vessel (only those in Apparently Good Condition).	Larvæ Hatched.
1	3	3
2	12	12
3	10	9
4	5	5
5	37	20
6	5	5
7	20	11
8	19	11
	111	76 = 68·468%

THE LARVA.

Development.

The stages have been found on the following dates at Gordonvale:—

Stage I.	Stage II.	Stage III.
January 6, 16 (reared) February 4, 15 (reared) February 23	March 1, 4, 10, 18, 21, 26	March 10, 11, 18, 21, 24, 27 April 1, 2, 4, 7, 8, 25 May 13, 15, 18, 26, 31 June 1, 7, 12 July 1, 3, 6, 8, 17, 27 August 7, 12, 14, 31 September 9 October 28 October 23, 31 (indoors) November 11 (indoors) December 6 (indoors)

Also Stage III. has been obtained at Cooktown, March 1.

From this data it is quite evident that the life-cycle is completed within the year.

Distribution in regard to Soils.

Of a total number of 351 larvæ from all the collections where the soil was recorded, 150 are from red volcanic soils, and 151 from black or clay loam—that is, an even distribution. But a proportionate calculation of the number of larvæ from the two soils gives a very different ratio. Also, 57,400 yards of plough furrows, red volcanic soil, yielded 138 grubs; 38,350 yards of plough furrows, loam, 19 grubs; or 52,923 : 10,906, or ·002404 and ·000495 larvæ per yard respectively.

Distribution as regards Habitat.

The larvæ of this species are very abundant in the vicinity of Gordonvale, especially around the roots of the blady grass (*Imperata arundinacea*) and other forest grasses, where they are much more common than in canefields. Specimens were also taken at Cooktown beneath *Imperata*. The species is therefore probably a native of the forest lands of coastal North Queensland. It appears to be one of the few Cetonids that does not live in decaying wood.

Of a total number of 322 larvæ from all collections from cane and forest, they are distributed as follows:—

Cane.		Forest, Grasses, &c.
58	..	264

Or a proportion of less than 1 to 4 from cane.

The following table confirms this preponderance in forest:—58,630 yards of plough furrows in cane yielded 39 grubs; 33,000 yards plough furrows in forest, grasses, &c., yielded 119 grubs; or 11,700 : 54,427, or ·000665 and ·00360 larvæ per yard respectively.

From separate collections the following table is compiled:—

Collection Number.	Source of Collection.	Number of Grubs.		Average per ard. Y
		Cane.	Grasses, Corn, &c.	
	Plough Furrows—Yds.			
1 ..	1,000	..	6 (forest)	·006
2 ..	910	..	7 (forest)	·00769
3 ..	600	..	13 (corn)	·0216
4 ..	1,200	..	15 (corn)	·0125
5 ..	1,600	..	28 (corn)	·0175
6 ..	5,760	..	31 (corn)	·00538
7 ..	1,260	5	..	·00397
8 ..	2,240	5	..	·00223

Distribution in Upland and Lowland.

Of 186 larvæ from collections from upland and lowland soils, they are distributed as follows:—

Upland.		Lowland.
77	..	109

But here again the data are far from conclusive.

Larvæ Living in Dry Soil for Long Periods.

That the larvæ of this species can live in dry soil for many weeks, or even months, has been proved several times. A single instance suffices. On March 12, seven Stage III. larvæ were placed in dry sifted soil in a small flower-pot; the cage was not watered, but left on an open veranda where the afternoon sun shone fully on it; on October 23 it was opened, six beetles in cocoons and one live larva being found. Had the larvæ not been nearly full-grown it is doubtful whether they would have survived. The full-grown larvæ may cocoon and thus live for weeks.

THE PUPA.

Length of Pupal Stage.

We have scant data of the duration of the pupal stage. Larvæ have been found in their cocoons as early as August 15, but it is probable they remain some weeks thus before pupating. A pupating larva in a cocoon taken from a cage on November 4 pupated and emerged on December 7, which would serve to show that the pupal stage may last no longer than a month. Pupæ taken from cages in the first week of November, but whose age was unknown, invariably emerged before December 7, and most before the end of November.

Manner of Formation.

All the pupæ we have examined were in well-defined oval cocoons, and were not enclosed by the larval cast.

Depth at which Formed.

In confinement, in wooden boxes with about a foot of soil, the

cocoons were always found within an inch or two of the bottom of the cage. We have no records of pupæ found in the fields.

Duration of Period of Pupation.

Pupæ have been obtained in confinement, on the following dates:—October 10, 27, 31; November 4, 6, 15; December 5.

But the stage evidently commences early, earlier than the earliest recorded date, as reared beetles have been obtained as early as October 23; thus, giving a month for the length of the pupal stage, we have had pupæ as early as September 23.

THE ADULT.

Emergence, Length of Life after Emergence.

In 1912-13 season, adults were first noted on December 12, thence right through January to middle of February. In season 1913-14, they were first observed on December 22, but none were seen after the end of January. On February 7 five adults were brought in from the forest and kept in captivity; the first died on February 12, the last on February 21. A single adult was found emerged on the surface of a cage, June 18, but this was only an isolated case.

Behaviour of Reared Adults.

As in *Lepidiota albohirta* and probably most other scarabæids, the adults of this species remain for many days in the earth before emergence. They do not even break the cocoon walls, but linger in a semi-dormant stage inside the cocoons. Thus six beetles found in cocoons on October 23 were still unemerged by November 11. From the actual transformation from the pupa to the adult, till its death, several months may elapse. Thus an adult reared on December 7 lived until February 3; a second reared on November 20 did not die until January 23. These reared beetles do not always reach a normal state of activity, though such is usually the case. For example, a pair of beetles reared about December 6 became actively alive by December 22. They were kept in a damp earth, without food, but mated, and the first eggs were obtained by December 29, the last on January 6; the female died on January 19, the male on January 31. Several similar instances were recorded, plainly showing that this species will mate and propagate without ever flying or without having had food; also that the female may live as long as two weeks after having finished egg-laying. This species, therefore, forms a striking contrast to *Lepidiota albohirta*, no reared adults of which reached a normally active state or went through the process of reproduction. Adults of this or a close ally were observed on flowers of the "fir-tree," growing in the bed of Cape River at Pentland, N.Q., in September.

Duration of Egg-laying Period of Reared Adults.

The egg-laying period of a reared adult may last for several days. The following table plainly establishes this fact:—

Number of Reared Females.	First Eggs Obtained.	Last Eggs Obtained.	Duration of Egg-laying Period.
			Days.
1	December 29	January 6	8
2	December 26	January 2	7
3	January 7	January 14	7
4	January 13	January 19	6

Number of Eggs Laid by Reared Adults.

The following table summarises our data:—

Number of Reared Females.	Eggs Laid.	Eggs per Female.
1	33	33
2	42	21
3	39	13=Average, 19

Thus one female may lay as many as 33 eggs, though the average number is considerably less.

Behaviour of Adults in Nature.

During the hot summer days of December and January the adults are very plentiful in the forested areas around Gordonvale. They may be seen flying round and round, low over patches of blady grass (*Imperata*), and individual specimens or mated pairs can be found clinging to the grass-stems. Flowering trees such as *Eucalyptus* sp. (an unknown species known commonly as the Box) and *Melaleuca* are frequented by them in large numbers, the species easily outnumbering all other flower-feeding beetles on these trees. Numerous mated pairs may be found among the flowers. A sharp shake given to a frequented tree causes the beetles to drop, and then fly before they reach the ground. They fly with great rapidity, and without lifting the elytra, shooting the wings out horizontally and at right angles to the body. There is much individual variation in the size of the white markings on the thorax, elytra, and venter of abdomen, but the females can be distinguished rather readily by their larger size, and the much smaller size of the light markings, these being sometimes almost wholly wanting. Fresh specimens taken from cocoons are of a rich chestnut brown colour, but after a day or two turn black.*

CETONID Sp. **No. 46.**

Our sole record of this species is as follows:—Three larvæ, in two stages, taken from decayed log on floor of jungle, Mundoo (Innisfail), N.Q., January 15, 1912.

No. 71.

Four Stage III. larvæ taken from under a termite's nest, Bundaberg, S.Q., March 9, 1912. This is our only record.

No. 539.

A single larva of an unknown stage from roots of native grasses in jungle, Cooktown, N.Q., February 28, 1914.

No. 349.

Scattered not uncommonly in cane rubbish-heaps, sandy loam, around Gordonvale, and feeding on the decayed wood therein. Stage III. larvæ have been obtained on the following dates:—April 17, 23; May 9, 23; August 4, 7, 12, 19, 24. A supposed Stage I. larva was found on March 27. The beetle remains unconnected.

* The adults of the same or a closely allied species were common on fir bushes in flower in the bed of Cape River, Pentland, Queensland, September, 1914.

XYLOTRUPES AUSTRALICUS Thomson.

THE EGG.

None obtained.

THE LARVA.

Development of Stages.

The stages have been obtained at Gordonvale on the following dates:—

Stage I.	Stage II.	Stage III.
July 27 August 4	June 26 July 24, 27 August 4, 6, 12, 19, 24	May 1, 12 June 13, 26 July 14, 27 August 4, 7, 12, 15, 19, 25, 29 September 1 October 7 November 25

Also Stage III. in confinement, throughout September, October, November, December, January, and also at Innisfail, October. From these records it would seem that the species has a life-cycle of more than one year.

Habitat.

The larvæ are very plentiful around Gordonvale, in heaps of cane trash or rubbish, being rarely met with in other locations. Our only other records are as follows:—From grass adjoining cane, Gordonvale, November 25, 1911; from red soil (cane ?), Innisfail, October, 1911; from a garden, Gordonvale, June, 1912; from red volcanic soil, forest, Gordonvale, May 1, 1914. It has also been taken from canefields rarely.

THE PUPA.

In our breeding cages, pupæ have been obtained from November 18, through December and January, into February, and perhaps even later; thus the pupating period is spread over three or more months. Of one batch of larvæ found on August 17, a few had pupated by the end of November, while others did not pupate until January.

Larvæ taken from cages on November 27 had pupated and emerged by January 19. A larva taken from a cage on October 29 pupated, and emerged on December 15. These records show that the pupal stage lasts less than seven weeks. The pupæ are not enclosed in the larval skin, and lie in large oval cells.

THE ADULT.

Emergence.

In confinement the first adult was obtained on December 4, thence right through to March, though the greater majority emerged during December and the first half of January.

Outdoors adults have been found on the following dates:—9th December, 1912; 12th March, 1913; 12th January, 1914; locality, Gordonvale.

Proportion of the Sexes.

Of our total number of reared beetles, 14 were females and 31 males.

Habits, &c.

Adults of this species not infrequently fly to lights. They can be found in large numbers feeding on the young branches of the cultivated tree *Poinciana*. A native food-plant is a species of *Philanthus*, adults having been seen on the younger stems of this tree growing on the banks of the Mulgrave River, Gordonvale. A specimen was found chewing a decayed piece of cane on the ground, March 12, 1913, Gordonvale.

Food of Larvæ.

On 28th July, 1914, at Gordonvale, digging in a rubbish-heap, clay loam near river, produced several Stage III. larvæ, one of which had its head buried in the dead branch of a tree, the mouth-parts full of sawdust. The soil surrounding was infiltrated with bits of dead wood; living vegetation scanty. The larvæ habitually feed upon decomposed vegetable matter in the soil.

CALLOODES GREYANUS White. **No. 655.**

THE EGG.

Length of Stages.

The following table shows the length of the stage; the eggs were deposited by a single female:—

Lot Number.	Number of Eggs.	Date Deposited.	Date Hatched.	Length of Stage—Days
1 ..	5	February 16-20 ..	By March 6 ..	14-18
2 ..	18	February 20-21 ..	By March 6-8 ..	13-16
3 ..	2	March 26-27 ..	By April 12-14 ..	16-19
			Average ..	16 days.

THE LARVA.

Development.

The stages have been found on the following dates at Gordonvale:—

Stage I.	Stage II.	Stage III.
March 6, 8, 12 (reared) April 14, 30 (reared)	April 13	June 26 July 4 August 15, 17 September 5

Our data are not sufficient to show how long the life-cycle lasts.

Habitat.

A species inhabiting the almost pure sand of the river-bed at Gordonvale, in which situation it is rather plentiful. It has not been found in any other sites. Reared larvæ, when placed in sifted loamy or organic soils, died within a month.

THE PUPA.

A single one found in sand, October. Like *Anoplognathus*, No. 434 and No. 576, the pupa lies enclosed in the larval skin, which is split its entire length down the meson of dorsum; the pupa lies with its dorsum against the venter of the cast larval skin. It is quite possible to identify the species from this larval skin, which remains in perfect condition, and can be handled freely if care is taken. A second pupa found in sand, 29th October, emerged 11th November.

THE ADULT.

Emergence.

An adult reared on October 30, from a pupa found in sand, is our sole record of the time of emergence. Beetles have been captured in the forest on the following dates:—February 5, 26, March 12, 16, December 24, 1913; January 11, March 31, April 12, 16, 1914; locality, Gordonvale.

Habits, Food-plants, &c.

Odd specimens are sometimes taken at light. A few have been found on foliage of forest trees, always singly or in pairs, never in numbers. The known food-plants are *Melaleuca* and bloodwood (*Eucalyptus corymbosa* (?)).

Length of Life.

Adults captured in the forest, and kept in cages with sifted damp earth, and leaves of their food-plant, have lived as follows:—

When Captured.	Died.	Length of Life—Days.
February 11	February 26	15
February 26	March 10	12
March 15	March 30	15
March 16	March 31	15

An adult reared from a pupa on November 11, and kept in confinement without food, died December 13.

Number of Eggs Laid, &c.

A single female was captured on February 13, and kept in confinement in a tumbler with sifted earth. Until February 16 no eggs had been laid; between then and morning of the 20th five eggs were laid; another egg was found at 5 p.m. the same day; at 8 a.m. 21st seventeen more eggs were deposited; and a final batch of five at 5 p.m. the same day. Thus twenty-eight eggs were laid in a period of not more than five days, twenty-two being deposited in twenty-four hours, or seventeen in fifteen hours. The beetle lived until the 26th. The eggs were laid singly or in clusters of two or three. A female caught at light on April 12 contained eggs in the ovary.

No. 434.—REPSIMUS ÆNEUS Fabricius

THE EGG.

None obtained.

THE LARVA.

Development of Stages.

The stages have been obtained at Gordonvale on the following dates:—

Stage I.	Stage II.	Stage III.
July 7	March 26 April 15 May 7 July 7, 23	March 12, 26 April 8, 13, 22 May 7 June 30 July 7 August 3, 24 September October November 6 (reared)

Also Stage III. at Mossman, N.Q., March 19. These data are not sufficient to decide the length of the life-cycle.

Habitat.

Around Gordonvale this species is rather common in the cane rubbish-heaps near the Mulgrave River, the soil somewhat sandy; and less abundant in the pure sand of the river-bed in company with No. 655. It is occasionally found in canefields, as the following records show:—From wet clay loam, canefields, Gordonvale, April 15, 1913; from sandy soil, under cane-stool, Gordonvale, May 7, 1912; from canefield, alluvial soil, Gordonvale, April 8, 1912; from alongside road, crawling over surface of ground, Mossman, March 19, 1912.

THE PUPA.

A single pupating larva from the sand of a river-bed, pupated on August 18. The pupa was enclosed in the larval skin, as in No. 655. Pupæ have also been taken from sand and sandy rubbish-heaps on August 24, September 15, and November 24.

THE ADULT.

Emergence.

In confinement, adults have been reared on the following dates:—August 26, September 22, November 24. A single beetle was caught at a light, Gordonvale, February 5, 1913. Nothing is known farther.

No. 576.

THE EGG.

None obtained.

THE LARVA.

Development of Stages.

The stages have been recorded at Gordonvale on the following dates:—

Stage I.	Stage II.	Stage III.
July 8	April 13 June 16, 30 July 8, 28 August 15, 17, 22, 25	June 16, 30 July 7, 23, 28 August 15, 17, 23 September 5, 10 October November 25, 26 (indoors)

From this scanty data it cannot be determined how long the life-cycle lasts. It will, however, probably be found to be longer than one year, since Stage II. larvæ in August cannot be expected to conclude the life-cycle by the end of the year. The larvæ have been found in almost pure sand in the bed of the Mulgrave River, but not elsewhere.

THE PUPA.

No pupæ have been obtained, though pupating larvæ have been taken from our cages on November 25 and December 18.

THE ADULT.

The adult of this species is not connected with the larva. It possibly is *Horonotus optatus* Sharp, a species which has been reared from cages containing supposed larvæ of No. 576 only.

ANOPLOGNATHUS BOISDUVALI Boisd.

THE EGG.

Length of Stage.

Lot Number.	Number of Eggs.	Date Deposited.	Date Hatched.	Length of Stage —Days.
1 ..	60	11-15 December ..	22-29 December ..	7-18
2 ..	23	16-22 December ..	By 2 January ..	11-17
3 ..	6	1-6 January ..	15-18 January ..	9-17
4 ..	44	20-30 December ..	By 14 January (larvæ several days old)	15-25
5 ..	63	20-30 December ..	By 14 January ..	15-25

Excluding the last two records, which are not exact enough, we obtain an average of 13·16 days; including the last two records the average is 15·9 days. The length of the stage is probably between the two averages, namely 14·53 days.

Duration of Period of Oviposition.

Eggs have been obtained from November 3 to January 6.

Manner of Deposition.

In confinement, eggs are laid single or in clusters of from two to six. None have been obtained out of doors.

Percentage of Larvæ Hatched.

When obtained in confinement, the eggs were placed in fine, sifted, damp earth, in glass vessels, at a depth of an inch or two. The following table shows the percentage of mortality:—

Lot Number.	Number of Eggs Placed in Vessel.	Larvæ Hatched.
1	44	20
2	63	18
3	6	4
4	55	31
5	23	21
	191	94

= 49·215 per cent. reared.

THE LARVA.

Development.

The stages have been found on the following dates at Gordonvale:—

Stage I.	Stage II.	Stage III.
November 22 (reared)	March 16, 18, 23, 24, 26	March 11, 13, 18, 23, 24, 26, 28
December 23, 29 (reared)	April 7, 10, 15, 19, 22, 29	April 7, 10, 14, 15, 16, 19, 22
January 2, 15, 18 (reared)	May 8, 6, 12	May 2, 6, 8, 11, 13, 15, 18, 21, 28
March 26	June 1, 5, 15, 30	June 1, 4, 7, 15, 17, 24, 26, 30
April 8, 17, 18	July 1, 6, 8, 11, 21, 31	July 1, 6, 8, 11, 15, 20
	August 3, 4, 7, 12, 22	August 3, 5, 7, 12, 17, 21, 27
	October 10, 27 (in cages)	September 22
	November 6 (in cages)	October 7
		December 24
		October 6, 24, 27, 31 (In confinement.)
		November 7, 12, 20, 26 (In confinement.)
		December 6, 8, 17, 29 (In confinement.)
		January 6 (In confinement.)

Also, Stage I. at Normanby, near Cooktown, N.Q., 5th February, at Babinda 27th January; Stage II. at Normanby 5th February, at Babinda, N.Q., 25th August, at Mossman, N.Q., 19th March, at Murwillumbah, Tweed River, and Harwood, Clarence River, N.S.W., May; Stage III. at Normanby, N.Q., 5th February, at Mossman, N.Q., 23rd March, at Childers, S.Q., 1st July, at Murwillumbah, Tweed River, and Harwood, Clarence River, N.S.W., May; at Babinda, N.Q., 27th January.

From these data it is obvious that the species has a life-cycle of more than one year. Thus Stage II. larvæ confined on 21st April were still in Stage II. on 11th November and similar records. These larvæ could not pass through Stage III., pupate and emerge, the same season or hardly so.

Distribution in regard to Soils.

Of our total number of larvæ of this species from Gordonvale of which record was kept concerning the soils, they are distributed as follows:—

Red Volcanic.		Clay and Black Loam.		Sandy Loam.
84	..	805	..	841

But of the middle column 643 were collected from one field. Thus the larvæ are commonest around Gordonvale, in the mixed sandy and loamy soils (not sand), near the Mulgrave River.

The following records show more truly the relative abundance in red volcanic and clay or black-loam soils:—60,700 yards of plough furrows, red volcanic soil, yielded 45 larvæ; 38,350 yards of plough furrows, clay and black loam, yielded 42 larvæ; = ·000757 and ·001095 larvæ per yard respectively.

Distribution as regards Habitat.

The larva of this species has been found by us in various districts throughout coastal Queensland, as far as the Clarence River in New South Wales. It is very common around Gordonvale, where it has been found in various situations—namely, in upland and lowland, volcanic and clay or black loam, forest, various grasses, and canefields; in natural jungle, beneath logs, &c., beneath heaps of decayed cane; in sandy loam, near the river; under native grasses in forest on coast range, 800 ft.

Of our total number of larvæ from Gordonvale of which record was kept concerning the habitat, they are distributed as follows:—

Canefields, Growing Cane.	Forest, Grasses, Corn, Fallow Land.	Rubbish, Decayed Cane, Dead Vegetable Matter, with no Living Vegetation.
873	99	826

But of those from cane 643 were collected in one field.

The following records show the relative number of grubs from canefields as opposed to fallow land, grasses, forest or corn lands:—65,000 yards of plough furrows, canefields, yielded 90 larvæ; 33,000 yards of plough furrows, forest, grasses, &c., 19 larvæ; or ·001385 and ·00057 grubs per yard respectively. Upland and lowland soils are both infested, but our data are not sufficient to show the relative proportions.

THE PUPA.

Length of Pupal Stage.

Our data do not allow us to give the length of the pupal stage. Probably it is similar to allied species.

Manner of Formation.

The pupa is enclosed in an irregular earthen cell, as in the *Lepidiotas* and others, but the sast of larva envelops it, as in *Calloodes greyanus* and No. 434. In confinement, larvæ have been found in cells as early as August 27, but they may remain thus some time before pupating.

Depth at which Formed.

Seceral pupæ found in sandy loam near the river at a depth of about 2 feet; one from same situation at 14 inches; one in forest, uncultivated land, at 6 inches.

Duration of Period of Pupation.

In confinement, pupæ have been obtained on the following dates:—October 21, 27, 28, 31; November 12, 19, 26; December 10; January 5, 30. In nature, pupæ were found on the following dates:—October 15, 21, 25; November 4.

THE ADULT.

Emergence.

In confinement, adults have been taken from our rearing cages on the following dates:—October 23, 25, 27; November 7, 10, 12, 17, 20, 22, 25, 28; December 8. Adults have been ploughed or dug up from cane-fields and elsewhere as follows:—October 21, 22, 24; November 13; December 16. Adults have been captured in the forest on the following dates:—October 28; November 20, 28, 30; December 10, 12, 16, 19; January 2, 7, 12; February 5, 12; March 10, 20, 29. One adult was found dead on ground in the jungle at Normanby, N.Q., February 5.

Length of Life.

The following table summarises our data:—

Lot No.	Number of Beetles.	Found.	Died.	Length of Life—Days.
1	1 ♂ (unemerged) ..	Nov. 7	December 10	33
2	1 ♂ (unemerged) ..	Dec. 5	December 11	8
3	2 ♂ 2 ♀ (unemerged)	Oct. 24	November 2 (3), November 13 1 ♀	9, 20
4	2 ♂ 2 ♀ (unemerged)	Oct. 22	October 31, 2♂; November 4, 1 ♀; November 5, 1 ♀	9, 13, 14
5	1 ♂ 1 ♀ (unemerged)	Nov. 13	December 11, ♂; December 22, ♀	28, 39
6	5 ♂ 8 ♀ (emerged)	Oct. 28	4 ♂, November 3; 1 ♂, 1 ♀, November 4 (Fed.)	6, 7, 9
			2 ♀, November 6; 1 ♀, December 8, 1; ♀ (Fed.)	25, 41
			December 26, 1 ♀; January 4, 1 ♀; (Fed.)	59, 62
			November 22 (Fed.)	68
7	1 ♂ 1 ♀ (unemerged)	Nov. 12	♂, December 27; ♀ January 4	45, 53
8	1 ♂ 1 ♀ (emerged)	Dec. 12	December 28	16
9	5 ♂ 5 ♀ (emerged)..	Dec. 19	4♀, 5♂, December 29; 1♀, January 3	10, 15

From these records it will be seen that the female lives longer than the male.

Proportion of the Sexes.

We have not made many large collections of adults, and hence our data on the relative number of the sexes is not conclusive. The following table sums up our data:—

Collection Number.	Source of Collection.	Beetles.	
		Males.	Females.
1	Miscellaneous collections from forest ..	19	23
2	Miscellaneous bred adults	17	15
3	Collected in forest	106	52
4	Collected in forest	30	24
5	Collected in forest	32	30
		204	144

= 58·6 per cent. males; 41·4 per cent. females.

Duration of Egg-laying Period of Adults.

Adults captured in the forest, and kept in captivity, have laid eggs on the following dates:—

Number of Females.	First Eggs Obtained.	Last Eggs Obtained.	Duration of Egg-laying Period—Days.
4	December 15	December 22	7
5	December 22	January 4	13

Number of Eggs laid by Adults.

Adults captured in forest, and kept in confinement, in cages containing damp sifted earth, and supplied with leaves, deposited eggs as follows:—

Number of Females.	Eggs Laid.	Eggs per Female.
4	91	22·75
5	120	24
		Average = 23·4

Behaviour of Reared Adults.

Adults reared in confinement almost always remained in a dormant or semi-dormant state until death, never mating, and rarely becoming active enough to devour the fresh leaves given them.

Behaviour of Adults in Nature.

Around Gordonvale the adults are very common in December and less abundant in November and January, being rarely seen in the other months mentioned in the emergence records—viz., October, February, and March. They feed almost solely on the young trees of the Poplar

Gum (*Eucalyptus platyphylla*), and usually on trees not more than 20 feet high, grown examples being occasionally attacked. They are voracious feeders, and quickly defoliate the young trees, numbers congregating on one. During the day they remain clinging to the leaves of the food-plant, and pairs are not uncommon. A sharp jerk to the feeding-tree causes the beetles to drop, when they bury themselves under any débris present; sometimes they fly. On one or two occasions, individuals have been observed flying strongly during the day, but the species is nocturnal in its habits.

The only other food-plant known is the Blue Gum (*Eucalyptus teretifolia*). This is a very rare tree around Gordonvale. Several of these trees were noticed on January 12, 1914, on the banks of the Mulgrave River, greatly damaged by adults of *Anoplognathus boisduvalii*. The trees were of considerable size (30-50 feet high) and the beetles were in large numbers.

Odd adults have been taken at lights.

No. 671.

Several larvæ by ploughing canefield, red volcanic soil, upland, Childers, S.Q., July 1, 1914. Nothing more is known of the species.

No. 667.

A single larva by ploughing, canefield, red volcanic soil, upland, Childers, S.Q., July 1, 1914, This is our sole record.

No. 653.

Several larvæ by ploughing canefield, Murwillumbah, Tweed River, N.S.W., dark loam soil, upland, under *Paspalum* grass, May, 1914; several by ploughing grass in fallow land, canefield, dark loam soil, lowland, Harwood, Clarence River, N.S.W., May, 1914; and two by ploughing canefield, red volcanic soil, upland, Childers, S.Q., July 1, 1914.

No. 646.

A rare species. It has been obtained as larva at Gordonvale on the following dates:—February 23, March 26, June 4, August 12; also at Cooktown, March 9. At Gordonvale the following habitats have been recorded:—From dark clay loam, forest, red volcanic soil, forest; from roots of *Imperata* grass; from cornfield, dark volcanic soil, lowland. Also, at Cooktown, one specimen from rich black loam under native grasses in forest.

No. 607.

Like No. 646, this is a rare species. It has been obtained as larva at Gordonvale on the following dates:—March 23, 27, April 3, 29, May 2, June 4; also at Cooktown, February 28, March 1. The following situations have been recorded at Gordonvale:—From forest, dark clay loam,

lowland; from red volcanic soil, forest, 350 feet; from forest, red volcanic soil, lowland; from yellow clay, natural forest; from roots of *Imperata* grass; from under log, grass in field. Also at Cooktown, from under native grasses in jungle, lowland, and from roots of *Imperata* grass alongside a roadway.

No. 609.

Not common, but not so rare as either No. 607 or No. 646. It has been recorded at Gordonvale on the following dates:—February 23, March 13, April 22, June 14, July 17, 20, August 11, 14, 26; also at Cooktown February 28. It has been obtained from the following situations at Gordonvale:—From under piece of bark on floor of forest; from forest, dark clay loam, lowland; from roots of cane, red volcanic soil; from fallow ground, grass, lowland; by ploughing canefield, dark volcanic soil, upland; by ploughing cornfield, dark volcanic soil, lowland; by ploughing grass and weeds, black loam soil, lowland. Also at Cooktown, from under native grasses in jungle, lowland.

The New South Wales specimens, which differ from the North Queensland ones, were obtained as follows:—By following plough, canefields, under *Paspalum* grass, May, 1914, four specimens, Harwood, Clarence River.

No. 364.

One of the dung-feeding series. The larvæ have often been found, encased in earthen spheres, at varying depths (usually 2 feet or more) canefields and grass lands, in the neighbourhood of Gordonvale.

No. 587.

Known only from the vicinity of Gordonvale, where it is not uncommon. Much of our data on this species are valueless, since we had confused it with No. 650. The records given, however, are authentic. The stages have been recorded on the following dates:—

Stage I.	Stage II.	Stage III.
Nil.	March 25 April 21 May 25 October 23 (indoors)	March 31 April 1, 15, 17, 21, 24 May 1, 25 June 25 August 26 September 4 November 13

It has been observed in the following locations:—Volcanic soil, canefield, four separate records; forest, clay loam, four separate records; forest, red volcanic soil, three separate records; forest, red volcanic soil, 350 feet; roots of the grass *Chrysopogon aciculatus*, one record each. The adult is unknown.

No. 650.

This species has been confused with the preceding, so much of our data have proved useless. The stages have been recorded on the following dates at Gordonvale:—

Stage I.	Stage II.	Stage III.
Nil	April 1, 14, 23	January 19 May 30 July 16 August 12, 17, 20, 26

Also Stage III. at Cooktown, February 2. Larvæ have been obtained from the following situations:—(1) From canefields, red volcanic soil, four records; (2) from cornfields, red volcanic soil, one record; (3) from grass and weeds, ploughing, dark loam, one record; (4) from canefield, dark loam, three records; (5) from under log in forest, one record; (6) from roots of *Cynodon* and *Chrysopogon* grasses, one record; (7) ploughing forest, dark loam, one record. Also in soil under log, forest, Cooktown, one specimen.

ANOMALA AUSTRALASIÆ Blackburn.

Three unknown larvæ of a scarabæid were taken from under cow-dung in forest, April 15, 1912, and placed in damp sifted earth in a flower-pot. The cage was opened November 11, two larvæ being found; one died shortly afterwards, the other pupated and emerged on December 24. It was this species.

Adults have been captured as follows:—Two at lights, December 11, 1912; one at light, December 17, 1913; one from foliage of banana, December 19, 1913. All records made at Gordonvale.

PENTODON AUSTRALIS Blackburn.

The following records:—Two adults from canefield, apparently boring into stalks of cane, January 24, 1912, Mackay, N.Q. (L. C. McCready); four adults reported to be eating shoots from cane-plants underground, Gordonvale, July 16, 1913; two adults following plough in grass, canefield, Harwood, Clarence River, N.S.W., May, 1914; one adult from canefield, Mackay, N.Q., April 2, 1912 (D. H. Walker).

MASTOCHILUS AUSTRALASIÆ Perch.

A dead adult found within a decayed log in jungle, Innisfail, N.Q., January 15, 1912.

CLADOGNATHUS TORRENSIS Deyr.

A female, doubtfully this species, caught at light, Gordonvale, February 2, 1913.

NESO PLANICOLLIS Blackburn.

A single specimen caught at light, Gordonvale, February 2, 1913.

LIPARETRUS ATRICEPS Macleay.

In November, 1913, while examining a number of cages containing scarabæid larvæ, and kept sunken in the earth in the laboratory yards, numbers of adults of this species were found. Their presence was no doubt merely incidental. On December 12, 1913, at Gordonvale, during the morning, great numbers were found feeding on the young foliage of *Eucalyptus platyphylla* and *E. corymbosa* (?).

SEMANOPTERUS DEPRESSIUSCULUS Macleay.

The following records:—Five adults found in soil under cane, Gordonvale, October 7, 1913; one adult, reared from larvæ found in canefield, July 27, and kept in confinement, October 19, 1913; one adult reared from a pupa found in soil under rubbish, November 1, 1913.

HORONOTUS OPTATUS Sharp.

One adult reared from a pupa found in sand under rubbish, Gordonvale, October 8, 1913; one adult reared from larvæ taken from the sand of a river-bed, September 9, and kept in confinement, December 29, 1913, Gordonvale. Probably the adult of larva No. 576.

ANTHONY JAMES CUMMING, Government Printer, Brisbane.